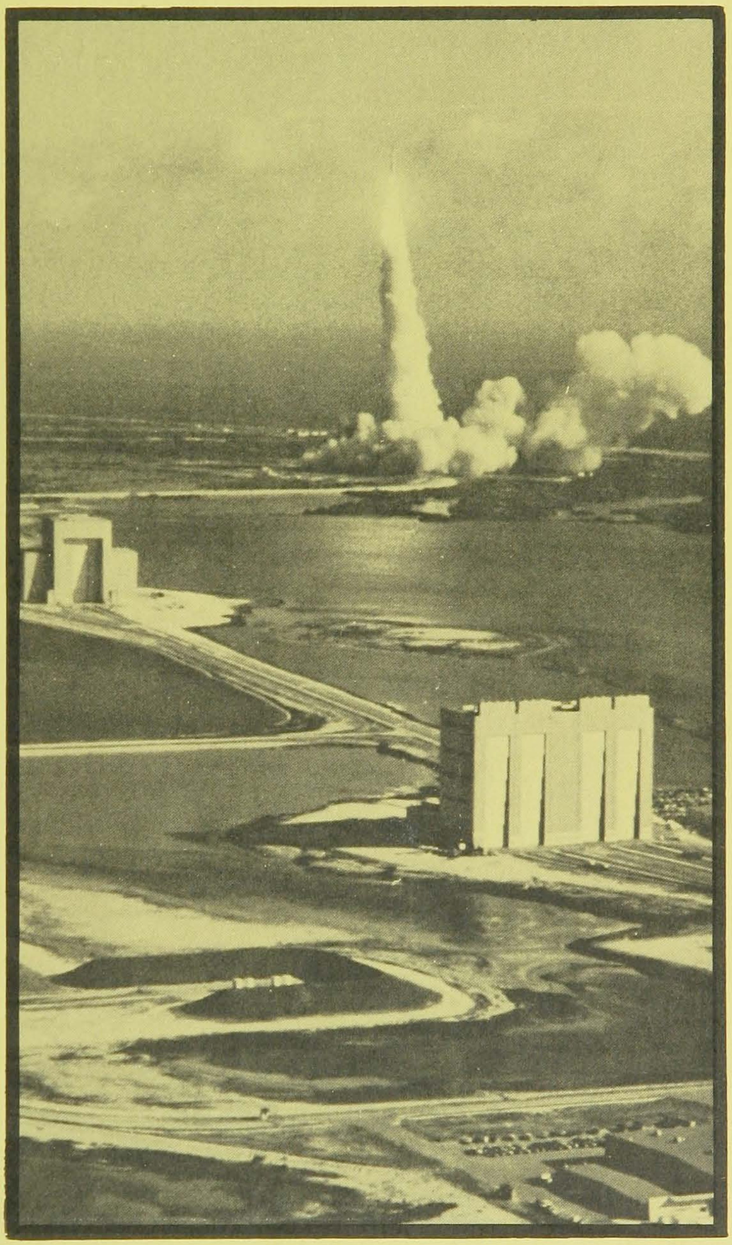
HISTORY OF CANAVERAL DISTRICT



1950

1971

SOUTH ATLANTIC DIVISION

U. S. ARMY CORPS OF ENGINEERS

Report Documentation Page

Form Approved
OMB No. 0704-0188

1. REPORT DATE **JUL 1971**	2. REPORT TYPE	3. DATES COVERED **00-00-1971 to 00-00-1971**
4. TITLE AND SUBTITLE **History of Canaveral District**		5a. CONTRACT NUMBER
		5b. GRANT NUMBER
		5c. PROGRAM ELEMENT NUMBER
6. AUTHOR(S)		5d. PROJECT NUMBER
		5e. TASK NUMBER
		5f. WORK UNIT NUMBER
7. PERFORMING ORGANIZATION NAME(S) AND ADDRESS(ES) **U.S. Army Corps of Engineers,South Atlantic Division,60 Forsyth Street SW Rm 10M15,Atlanta,GA,30303**		8. PERFORMING ORGANIZATION REPORT NUMBER
9. SPONSORING/MONITORING AGENCY NAME(S) AND ADDRESS(ES)		10. SPONSOR/MONITOR'S ACRONYM(S)
		11. SPONSOR/MONITOR'S REPORT NUMBER(S)
12. DISTRIBUTION/AVAILABILITY STATEMENT **Approved for public release; distribution unlimited**		
13. SUPPLEMENTARY NOTES		
14. ABSTRACT		
15. SUBJECT TERMS		

16. SECURITY CLASSIFICATION OF:			17. LIMITATION OF ABSTRACT	18. NUMBER OF PAGES	19a. NAME OF RESPONSIBLE PERSON
a. REPORT **unclassified**	b. ABSTRACT **unclassified**	c. THIS PAGE **unclassified**	**Same as Report (SAR)**	**129**	

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OF

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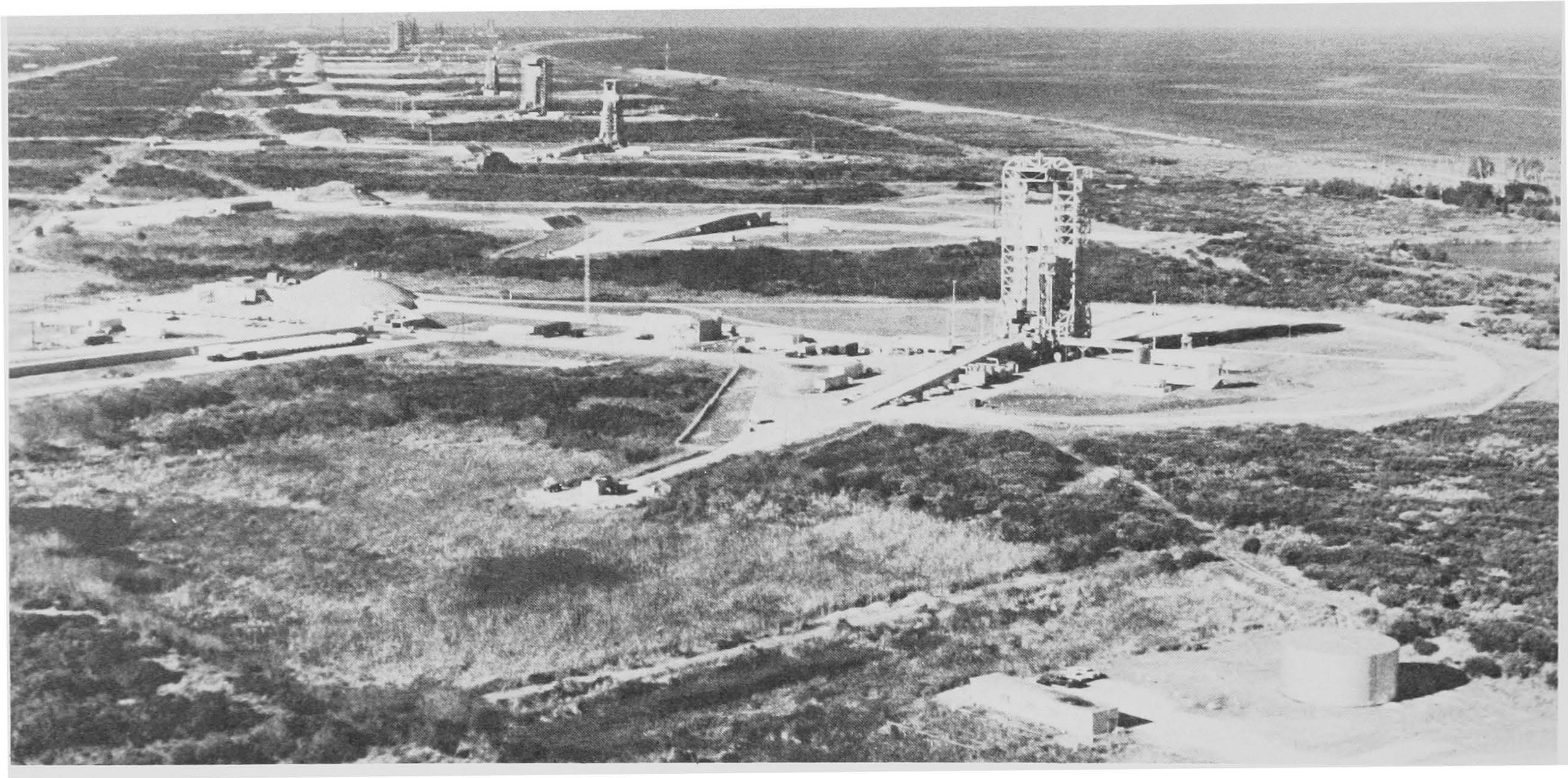
PRINTED IN JULY 1971



Gantries confront the tireless Atlantic in this 1967 aerial-oblique view of Cape Kennedy.

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FOREWORD

Although it is the youngest District of the Corps of Engineers, the Canaveral District has nonetheless had an eventful and exciting history, tied closely and indispensably to the history of America in space, the national development of missilery and the journeys of man to the moon.

The earthbound installations essential to these achievements have been our responsibility, and the men of the Corps who have served here may surely take pride in the accomplishment of heavy-weight engineering programs, critical to man's penetration of this new and exacting frontier.

Because the District was established but eight years ago, the history of its predecessor, the Patrick Area Office of the Jacksonville District, has been distilled at the outset of this work in order that the full 21-year participation of the Corps of Engineers in the Canaveral/Kennedy effort may be viewed in perspective and have continuity as a whole.

Naturally, the recording of events is always best done by those close-in on their occurrence. This is especially so when the passage of time, the diffusion and dispersal of records and the transfer of key individuals has occurred. In the present instance, it has been our good fortune to secure a seasoned colleague as our Historian, a man who was actively involved from the beginning and who himself held key posts in both the Patrick Area Office (from its inception) and later within the Canaveral District.

E. R. "Ed" Bramlitt, now retired after 30 years' civil service with the Corps, arrived at a raw and virginal Cape Canaveral in May of 1950. His close association with all of the people and events involved from that time forward, his keen capacity for observation, plus an intimate knowledge of the day-by-day history as it occurred, made him a logical choice to undertake this project.

His end product sets forth the salient facts of our history in the Canaveral District, portrays the unique design and nature of many of the projects involved, and will I am sure be a valuable work to those who may in the future become concerned with the activities of the U. S. Army Corps of Engineers in this area from 1950 through fiscal 1971.

V. D. STIPO
LTC, Corps of Engineers
District Engineer

ACKNOWLEDGMENTS

As Historian for the Canaveral District, Corps of Engineers, I wish to acknowledge the assistance of all those who lent a hand in this project, and to respectfully dedicate this volume to the many individuals whose hard work and dedication helped to actually make the history that is here only recorded.

I want particularly to acknowledge the aid of my friend and associate Donald E. Eppert for his fine memory and random personal files; Mr. Marven R. Whipple, Historian of the Air Force Eastern Test Range, for his help and guidance, and Col. Charles E. Thomson, Jr., (USAF, Ret) for his writing and editorial assistance. All photos and illustrations are by NASA, the Air Force and the Corps of Engineers.

E R Bramlitt

E. R. Bramlitt
Historian

CHAPTER I

IN THE BEGINNING

When Charles Lindbergh took off in 1927 for his famed flight to Paris, it was quite natural that nobody paid much heed to the runway from which he lifted. The eyes of the world, as always, were on the man and his machine. This was the big story. Then as now, the basic pull of "human interest" ran mightily toward the man in action, the hardware in action, the magnitude of the thing being done.

And as it was with Lindbergh's runway, so it was for a while with the tons of steel and stone, the yards-thick slabs of reinforced concrete, unique flame deflectors, underground silos, towering gantries and all the space-age ground installation that was brought together to test and prove intercontinental missiles and to launch Americans into space and, most recently, to the moon.

A closed Security Base wherein great events occur aroused a tireless curiosity, and the momentous pace of the missile-space era so whetted public interest that the barriers had to come down at Cape Canaveral. Today the novel works of man at the Cape are landmark history. Thousands of people tour to see them every year.

Since the engineering and construction job was as essential to America's space story as the giant rockets themselves, the role of the Corps of Engineers was a prime factor from the beginning at Cape Canaveral/Kennedy.

From the end of World War II through the 1940s, a lot of quiet brainpower had busied itself feverishly in the realms of missile and space research. Much of the fruit of this effort remained shackled to drawing boards for want of a long-range testing and proving area. In May of 1949, President Truman signed a bill to provide such a facility, and the following year the Air Force's Long Range Proving Ground was formalized, with the status of a major air command and with a mission to develop what has since become the Eastern Test Range.

Early in 1950 the Corps of Engineers was designated as the construction agency for the Air Force at Cape Canaveral and Patrick Air Force Base. In May 1950, the Jacksonville District, Corps of Engineers, moving under forced draft against a launch that would occur two months later, awarded a contract for the first launch pad at Cape Canaveral and dispatched three engineers to establish an Area Office. This small cadre, two men from the Clewiston Office, Okeechobee Flood Control Area and one from the Miami Beach Resident Office, helped their contractor mix and pour the concrete for Pad 3 (the first launch pad built) before they could

find time to establish an area operations office at nearby Patrick Air Force Base. In fact the pace of events moved so fast that their location at Patrick was not functioning until September.

The first launch, Bumper 8 - a German V-II rocket with an Army WAC Corporal missile as second stage - had a mission to prove feasibility of "staging" (or separation) of one rocket from another in flight. Bumper was launched from Cape Canaveral on July 24th 1950, just 45 days after the ground had been levelled to receive the foundation for its launch bed. Five days later another Bumper jumped away.

Under the pad, walk-through tunnels had been contrived to carry the circuitry and high pressure air. From a crude sandbagged blockhouse 500 feet away, power cables lay along the surface of the ground to a "safed" terminal at the pad. Three roads into the launch complex, (which would later include Pads 1, 2 and 4) had been stabilized sufficiently to bring in the launch hardware on a "don't stop or you'll bog down" basis.

Completion of this initial contract by the Patrick Area Office, Corps of Engineers, on a full "beneficial occupancy" status did not occur until the end of August. But two pioneering rockets had already made the South Atlantic unvirginal to missilery.

Meanwhile, construction was put underway by the Corps of Engineers on seven technical buildings, a launch area water system, security fences, patrol roads and a Gate House at the south end of the Cape which has since become a storied gateway to outer space. At Patrick AFB (much run-down by disuse since World War II and recently acquired by the Air Force from the Navy), the renovation of a dozen buildings went forward and additional power, water and related support requirements were met. Key roadbeds were laid to link the new Cape gate with the outside world.

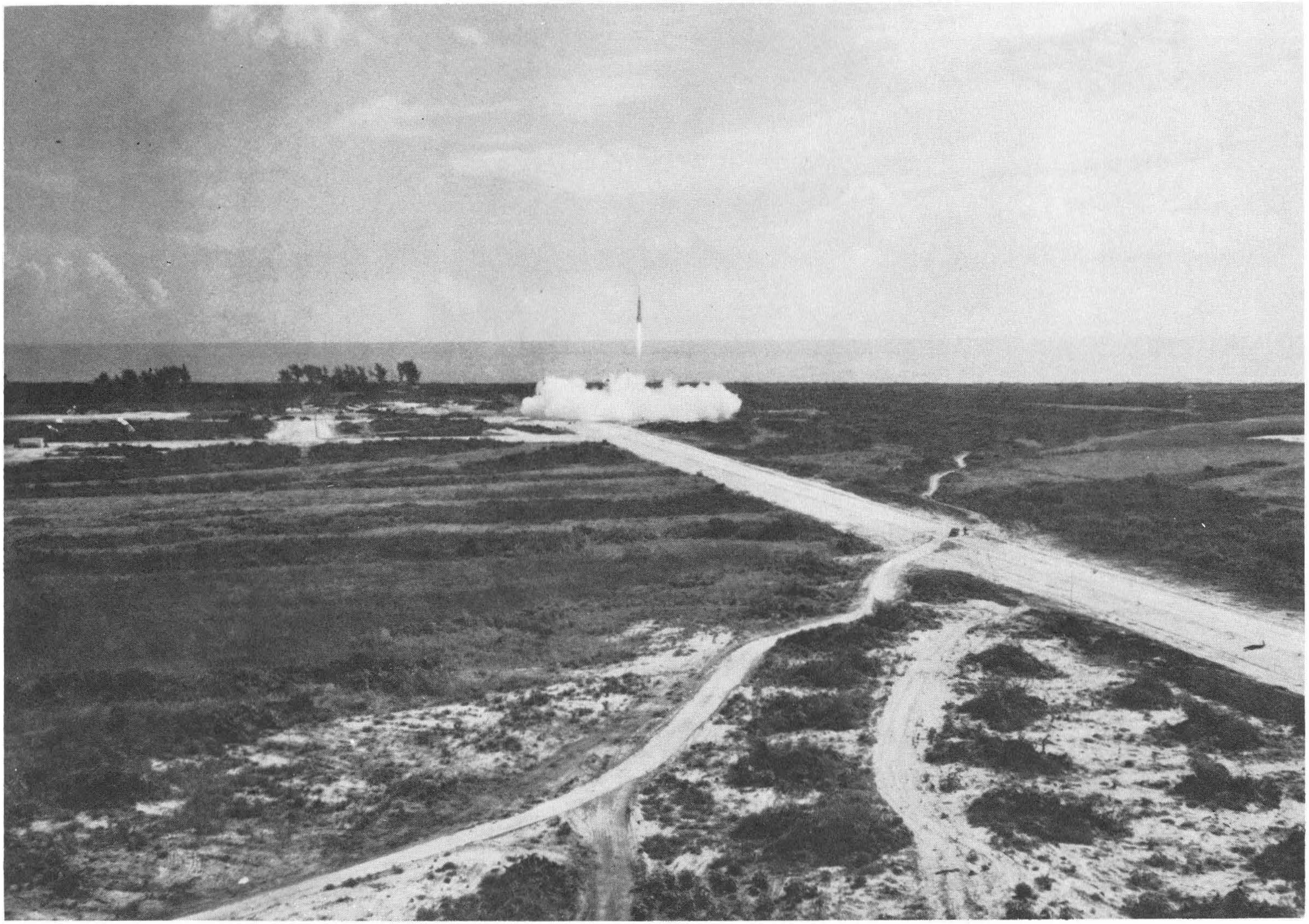
In its first six months, the Patrick Area Office under the Jacksonville District, Corps of Engineers, had managed the supervision and inspection of $1.7 million in construction contracts, and had $700,000 for roads in progress.

On the ground, the space age was underway.

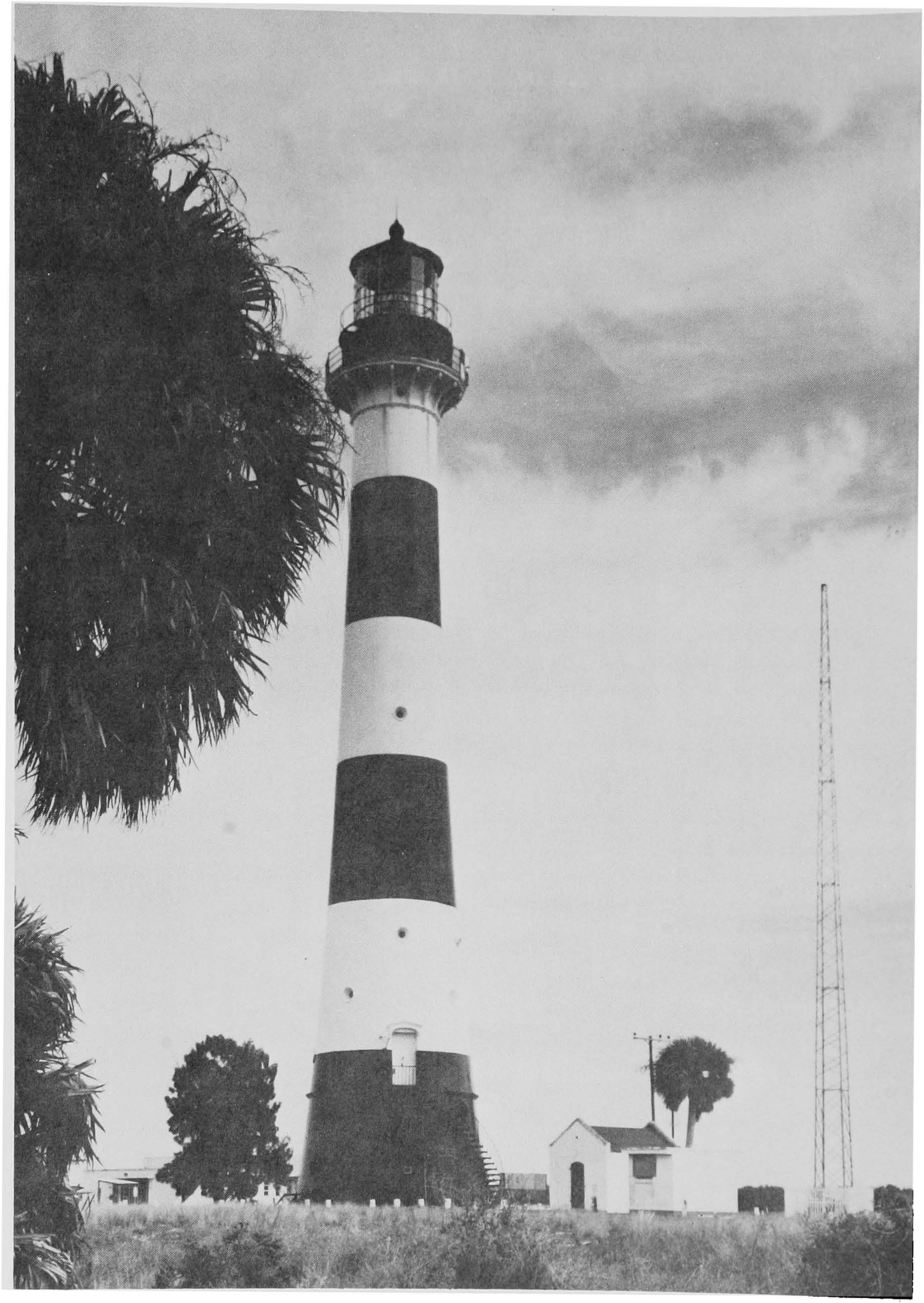
Until 1949, Cape Canaveral had been of interest mainly as a hazard to navigation, known to mariners for its ancient lighthouse flashing warnings of the shoals that spread from the Cape into a hostile sea.

The Cape -- it was Cape Canaveral then, and today is officially Cape Kennedy -- is perhaps the outstanding geographic feature of Florida's east coast. It juts abruptly southeast into the Atlantic, and has been likened by map readers to George Washington's nose in profile.

The Canaveral real estate was primitive and untamed, and not without hazard and hardship for those who took the first footholds there.



Bumper starts it all with launch from a barren Cape Canaveral in July 1950



Famed Cape Canaveral landmark, ancient lighthouse warns mariners of coastal shoals in Atlantic Ocean.

Mosquitoes were indeed big and plentiful. All visitors, inspecting parties and the like were sprayed liberally with repellents, and the Air Force regularly sprayed the area from a converted B-17. Snakebite kits were common, and a comfort.

One early engineer recalls the incident of a scrubbed launch when liquid oxygen (super cold at -297 fahrenheit) was pumped from the rocket into an adjacent pond where an old alligator still retained rights of eminant domain. The result of the liquid oxygen-alligator formula was one frozen alligator. Thinking the 'gator dead, Corps personnel took him from the pond. The Florida sun warmed him up, very much alive. There was an immediate separation. (But perhaps not one of fact from fancy.)

Bumper on its maiden voyage, and later the Bomarc, Snark and Matador air-breathing missiles flew southeasterly over waters that were to become important to missile development and testing -- the Atlantic approaches to what is today Port Canaveral.

Below the early flight paths, the Corps of Engineers undertook - at first for commercial usage - the dredging of a deep-water harbor at Cape Canaveral. This had been the dream of two generations and was finally accomplished during the period from June 1950 to January 1952. A barge canal of 8-foot depth and a hundred feet wide would run easterly from the Intracoastal Waterway in Indian River across Merritt Island and through Banana River to the barrier strip between Banana River and the Atlantic Ocean. Here a land-locked turning basin about a thousand feet wide with an average length of 1900 feet and a project depth of 27 feet was dredged with the dredged material being placed to build a protective dike. The dredging continued eastward through the barrier strip creating an entrance channel 300 feet wide to the 27-foot contour in the ocean. Starting in 1953 south and north jetties were constructed to help eliminate shoaling in the entrance channel caused by a literal drift of sand in flotation.

The existing project was enlarged in 1956-1957 with military funds to provide an entrance channel in Canaveral Bight 36 feet deep, thence 34 feet deep through the barrier beach, and a turning basin 33 feet deep. In 1961 the project was further enlarged to provide depths of 37 feet in the approach channel, 36 feet in the entrance channel, and 35 feet in the turning basin. The barge canal connecting with the Intracoastal Waterway in Indian River was also enlarged to 12 feet deep and 125 feet wide. At the same time a barge canal lock 90 feet wide and 600 feet long west of the harbor dike was authorized and construction was accomplished at a later date under the Jacksonville District. Marginal wharves, warehousing, personnel accommodations and utilities were built for the Military on the north side of the harbor. Altogether by this time the Patrick Area Office under the Jacksonville District Corps of Engineers had disbursed over $10,000,000 on the construction of Canaveral Harbor and the Military facilities.

Canaveral Harbor, View West December 1961

Man-made Port Canaveral, built under Corps of Engineer contracts and supervision in 1950-52, has since undergone frequent modifications in depth and facilities. This 1967 view shows missile tracking ships in right center and Navy's OBSERVATION ISLAND test ship at left center.

The Air Force Command at Patrick AFB had two 85-foot vessels then, for use in patrolling waters off-Cape during launch periods and for crash rescue missions in the Atlantic off Patrick as required. The boats were based 80 miles south at Fort Pierce, a bit remote for the job.

Perhaps there was somewhere at that time the foresight to project the ultimate arrival of nuclear submarines at Port Canaveral, the berthing there of the Navy's instrumented test ship OBSERVATION ISLAND and the 14,300-ton radar-festooned missile tracking ships ARNOLD and VANDENBERG. But in point of immediate fact, the Port at the outset was seen as useful for commercial fishing and shrimp vessels, for ships engaged in downrange supply missions, a point of arrival for heavyweight equipments for the missile test complex, and a closer-home base for the utility boats at Fort Pierce and other support vessels.

Should it ever have to defend its existence, this small man-made harbor -- among all those of the free world, either natural or contrived -- will wear well in the weather. For here in the 1960s and 1970s, all nuclear submarines of the U. S. Navy would come to qualify their crews for ballistic missile competence in an altogether new Naval age. Here they would on-load their incredible artillery (Polaris and Poseidon) and slip back quietly into the Atlantic to ascertain how well they could lock-on to a distant target, fire through fathoms of ocean and miles of sky, and guide their bird to his kill. Just as the landside engineering, architecture and construction would change to meet the missile age head-on, so would seamanship.

Also in 1951, the Jacksonville District, Corps of Engineers, let the first contracts ($637,500) for the famed Cape "Skid-Strip." Built for recovery of the aerodynamic winged missile SNARK, the strip was carved and levelled across the palmetto wastes to a length of 7,000 feet, 300 feet wide. Its original surface was of compacted limerock fill, on which SNARK (with its landing skids) could set down after long rectangular controlled flight missions. SNARK was a good idea at the time. Seen as an unmanned nuclear package with a 6,000-mile range and 600 mph cruise, it was among the last of the pre-ballistic weapon concepts for strategic air strikes. In the test phase, its responses to flight and cruise control could best be read through long box-pattern flight missions -- and quite sensibly it could be tested at least expense if recovered after flight. Actually, of 97 SNARKS launched, many were programmed to hit South Atlantic target areas straight on (and some did). But 13 were recovered at the Skid Strip, as were seven Navajo X-10 missiles which also went into the discard with the ultimate Nationalcommitment to ballistic missiles for strategic weaponry.

But the Skid Strip was there. In May, 1955, the Corps of Engineers was given the mission of lengthening it by 3,000 feet with a 1,000-foot overrun at each end. It was later restabilized, asphalted as an auxiliary air-strip for the Missile Test Center command. Today it is a hard-topped asphalt concrete 10,000 foot runway that has accepted Air Force One, received three Presidents (Eisenhower, Kennedy, Johnson), and is

an all-weather facility with permanent control tower. It has annually received about 550 arrivals of critical missile-space test research and logistics cargoes.

Approximately $2.8 million were spent on the Skid Strip to bring it to its present configuration -- and like Port Canaveral -- grew with the age it was born to. Looking ahead, one needs little imagination to see "The Strip" receiving Space Shuttle landings and other craft of the future.

Launch of USAF Snark Missile from Pad 2 at Cape Canaveral. A
down range flight with return for recovery at the Skid Strip.

CHAPTER II

THE CORPS DIGS IN

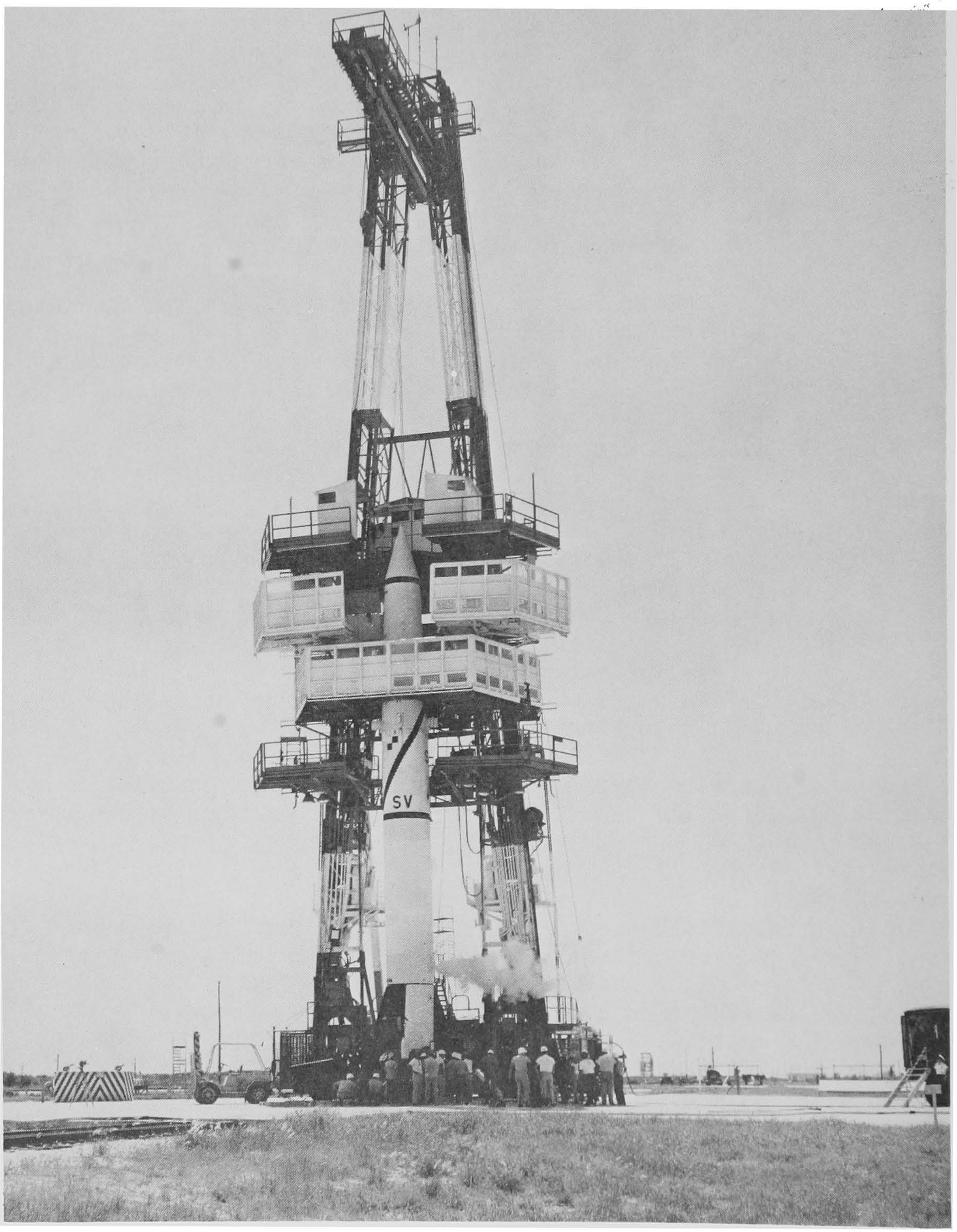
Improvisation was the keynote at Cape Canaveral in the early 1950s. The days of standardization in launch complex requirements and operating procedures were still ahead. Bumper's crude sandbagged blockhouse had been matched by a flimsy "painter's" scaffolding to service the vehicle. For LARK, first launched in October 1950, an Army Tank served as the blockhouse, as did a sandbagged foxhole for MATADOR.

Today's famed Cape skyline of towering gantries had its beginning with REDSTONE's service tower in 1953. This was the first service stand to give operating personnel access to all levels and locations on a vertically launched ballistic missile -- and in principle it quickly became standard.

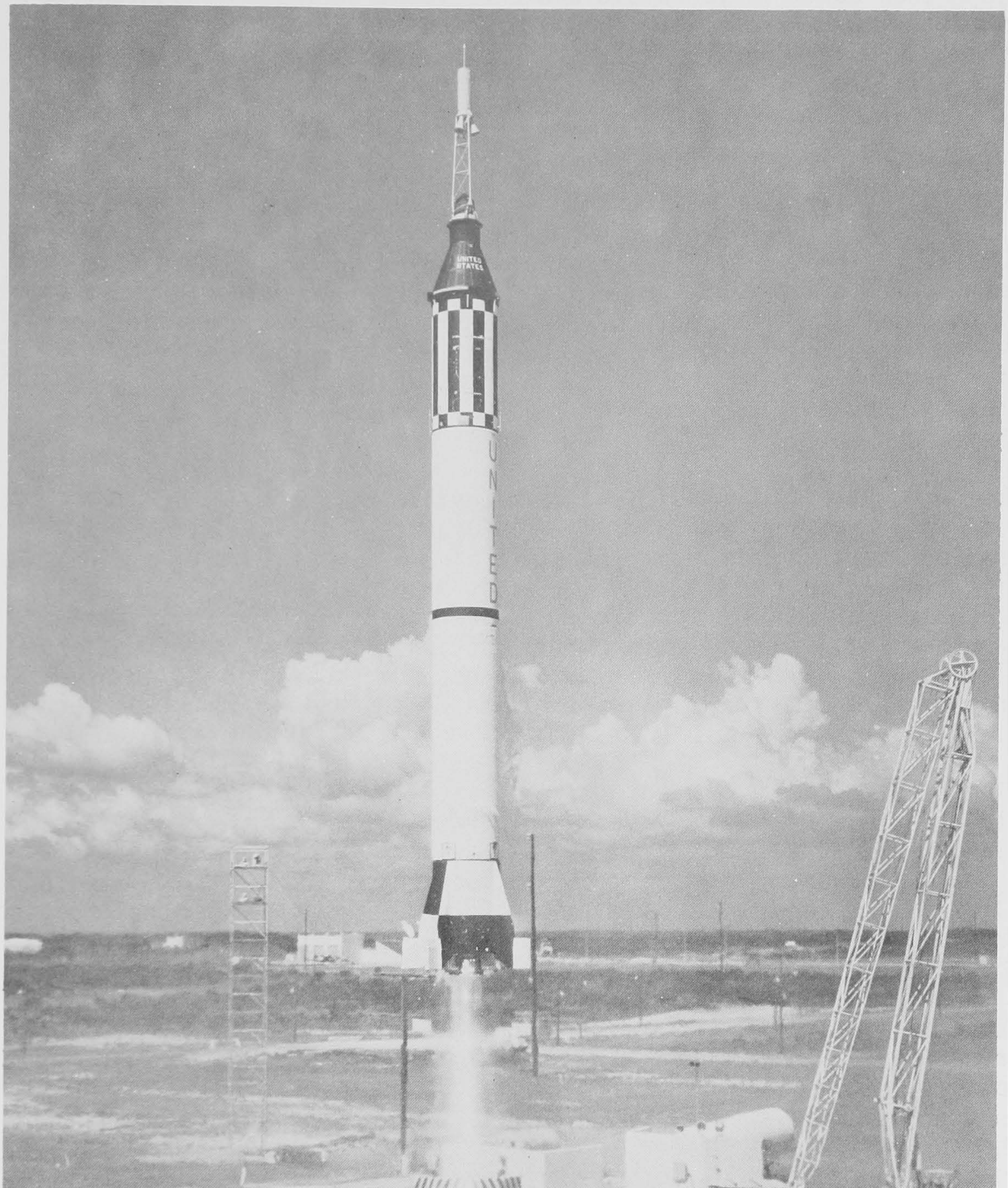
Redstone's launch complex (5 and 6) was delivered by the Corps of Engineers at a total cost of $657,444. Its service tower or gantry came at an additional $420,000. The missile itself, originally designed as a 200-mile range tactical weapon, had 29 launches prior to May 5, 1961, when it entered the history books as America's first manned space launch vehicle. Mercury-Redstone 3 was an Army missile, with a Naval officer flying as astronaut, from a launch complex built by the Corps of Engineers, on an Air Force installation, under the auspices of the then very young National Aeronautics and Space Administration. Other circumstances may often be duplicated, but not these.

Redstone's service tower evolved out of efforts to provide a more economical and versatile structure than the gantries used by the Germans in V-2 experiments in World War II. A reclining type single-mast structure with cantilevered access platforms capable of encircling the missile was determined to be the most advantageous device for Redstone. An "A" frame mast, as the backbone supporting the cantilevered access work platforms, towered 140 feet above the launch pad. The mast was supported by a large structural steel base, mounted on railway tracks and capable of moving under its own power to and from the missile. Elevators travelled up and down the mast, with stops at various work-levels, to a 15-ton hammerhead crane mounted at the top of the structure. A follow-on of the open-faced masts used in oil fields, the Redstone service tower was built by Noble Company of Oakland, California, transported to Cape Canaveral in 14 railway cars and re-assembled at the launch site (by seven Noble men, within five days after delivery) and made immediately available to service Redstone's maiden voyage.

Redstone literally put "life" in the United States space program.



Redstone Service Tower was first (1953) of long and imposing row of missile gantries confronting the Atlantic at Cape Canaveral/Kennedy. Redstone booster itself put first American in space (CMDR Alan Shepard 1961).



Launch of America's first man in Space on the Mercury-Redstone MR-3 from Cape Canaveral Launch Site on May 5th, 1961

Its last three launches did this. On January 31, 1961, a young gorilla named HAM (now about 14 years old and a resident of the Smithsonian Zoo in Washington, D.C.) rode Redstone into space and back. Next came MR-3 with Commander Alan Shepard -- first U. S. man in space -- followed by the late Air Force Major Gus Grissom (Mercury-Redstone 4, suborbital, July 21, 1961).

After 31 launches, Redstone -- along with the concrete and steel that had helped it go -- was retired as a museum piece at Cape Kennedy.

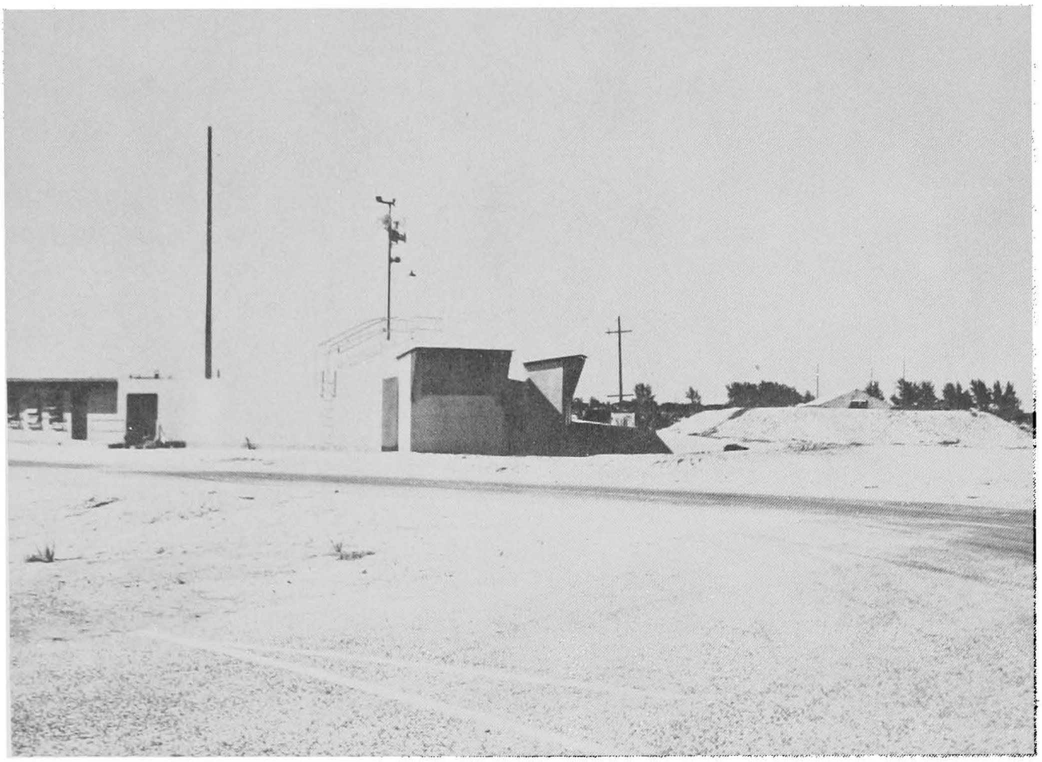
Just as Edison's name is not on every light bulb, nor Marconi's on every radio, neither is the Corps of Engineers' engraved on every rocket successfully launched from a complex constructed under its supervision. At the same time, if this history tends to provide an identification of the Corps of Engineers among the paragraphs relating to its achievements at Cape Canaveral, no apologies are made. The Corps was there as a major contributor.

When the Patrick Area Office, Jacksonville District, U. S. Army Corps of Engineers learned in the Mid-1950s that the national decision on missiles was altogether ballistic, it also was recipient of new specifications with respect to force-loads on pad, launch thrust loads, flame bucket requirements (to carry off peak heat and flame at ignition and launch point), communications construction criteria, specifications for blockhouses, missile assembly buildings and a host of related needs -- many of them demanding total innovation in design and construction technique.

The creation of the National Aeronautics and Space Administration on October 1, 1958, and the legislated merger into NASA of the Army Missile Command at Redstone Arsenal, Huntsville, Alabama, put the Corps of Engineers to work for a new national space agency. The then-maturing missile age simultaneously brought forth new design and heavy construction criteria from the Army, Navy and Air Force for critical combat missile test-base needs.

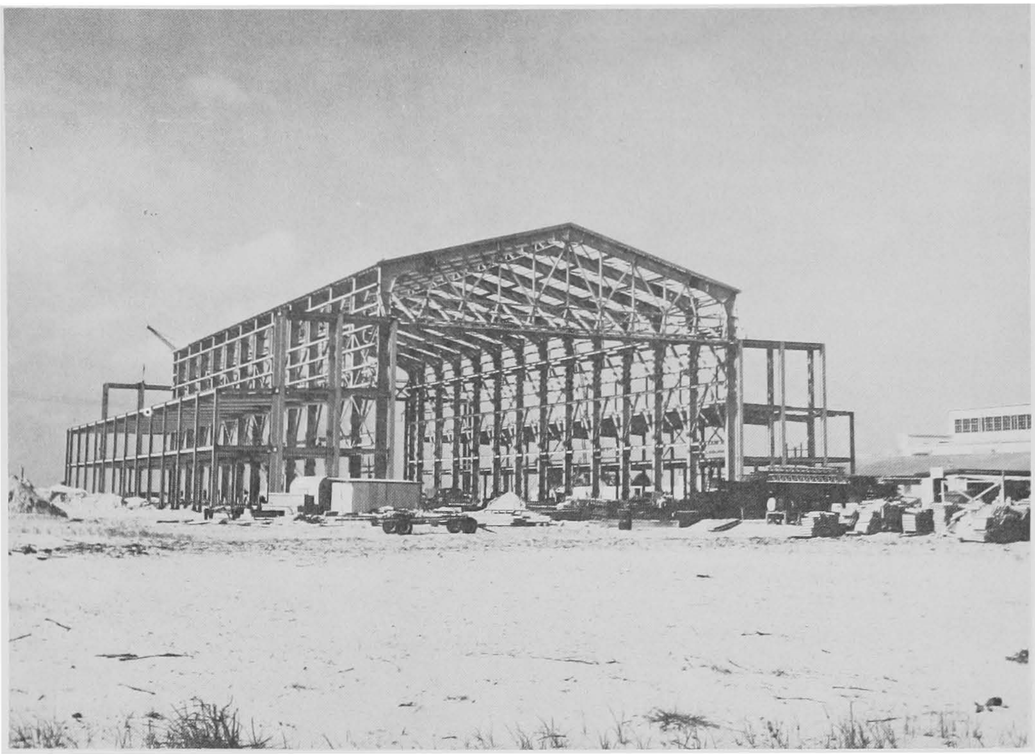
Each missile coming on stream had clear similarities to others in its ground environmental needs and operational demands. Each, in its test phase, needed a missile assembly and checkout building, transport access from assembly area to launch complex, a launch pad to meet its own thrust and flame characteristics, gantry service tower, blockhouse for on-site launch command and control, and a net of power, fuel and communications feeds that would bring it to life. This pattern of key requirements, once seen, tended to narrow variations largely to a matter of degree.

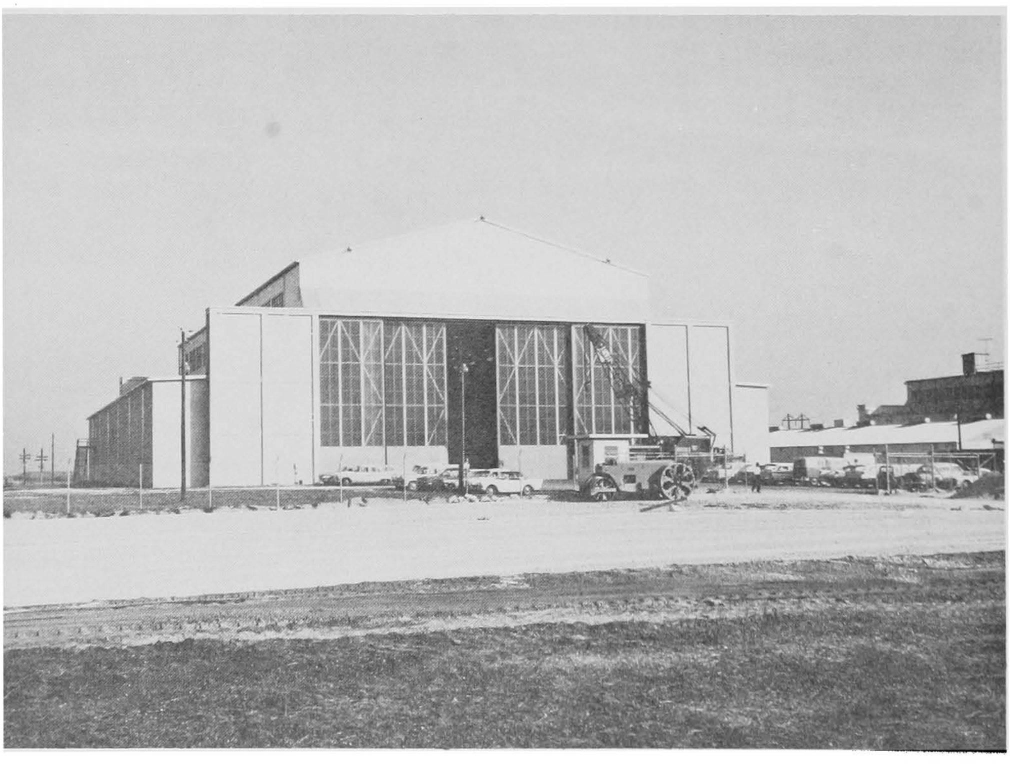
Blockhouses, for instance, were uniformly igloo-shaped and located at a mean distance of 750 feet from the launch pad. Housing the action-level communications, control consoles and verying arrays of instrumentation, these domed bastions gave protection to the nervous-system of a



First blockhouse (above) with two launch rooms facing Pads 1 & 2, is contrasted to a typical dome-shaped structure which later became standard blockhouse configuration. (below)

Blockhouse, Complex 34 - Saturn 1 CCMTA, Patrick AFB, Florida





Corps of Engineers built 21 Missile Assembly Buildings at Cape, last 16 of which had standardized steel framework with exterior appearance of aircraft hangar.

missile launch at its "skin level" and protected the launch crew.

In blockhouse construction, a large excavation was filled with sand and the reinforced concrete flooring and walls were poured in two layers, with a cushioning layer of sand in between -- to absorb the shock should a missile explode on-pad or impact on or near the launch site.

In the case of Atlas Complexes 11, 12, 13 and 14, inside walls of the 12-sided, dome-shaped structure were 10½ feet thick at the base, with 40 feet of sand around them. A retaining wall around the base held the sand in place. At the apex of the Atlas igloo, the inside walls were 5½ feet thick, with seven feet of sand uniformly covering them, and with an overall gunite-concrete shell holding the sand in place. For Atlas Complex 14 (Mercury Atlas) an interior floor-space diameter of 60 feet was prescribed, but such particulars varied depending on the missile involved and its mission parameters from a given launch pad.

Including a reduction in cost and in the time required for design, blockhouses for the intermediate range ballistic missiles (IRBM) all used the same basic structure, with interior details varied to suit the specific missile system. It was clearly uneconomical to provide absolute safety from the worst possible accident -- but since a blockhouse functions to shelter and protect essential equipment and personnel during the last few minutes of count-down and immediately after launch, actual design was based on an assumed explosive force. In the case of the IRBMs the reinforced concrete structure had walls two feet thick, a dome of 5½ foot thickness at its base and eight feet at its crown. Viewing ports were protected by three layers of armored glass, each four-inches thick.

As for missile assembly buildings (in the pre-Saturn, pre-Apollo, pre-Titan III days) twenty-one were built under Corps of Engineers supervision at Cape Canaveral at a cost of about $1.5 million each.

Fundamentally, a missile assembly building is seen as a hangar, receiving its missile as a child of parts (usually via air arrival at the "skid strip"), and re-birthing it whole for launch. However, a missile assembly building makes salient departures from a normal hangar. Floors of the main bays, as well as the ground-floor shops, are liberally laced with covered trenches through which run instrumentation and power circuits, the means of connecting laboratory equipment to the missile to test and read-out component adequacies within the rocket prior to its transfer to the launch area. Such checkouts invariably demanded direct current power, 400-cycle alternating current, highly compressed air and other gasses.

For the last sixteen Missile Assembly Buildings (MAB) constructed, the Corps of Engineers managed to standardize design of the basic framework, with each building incorporating about 42 tons of structural steel and providing floor space of 40,956 square feet. This standard frame not only reduced design time but also permitted procurement and fabrication of the steel to go forward while the balance of the building's special design needs were being completed. Those who were there estimate that this

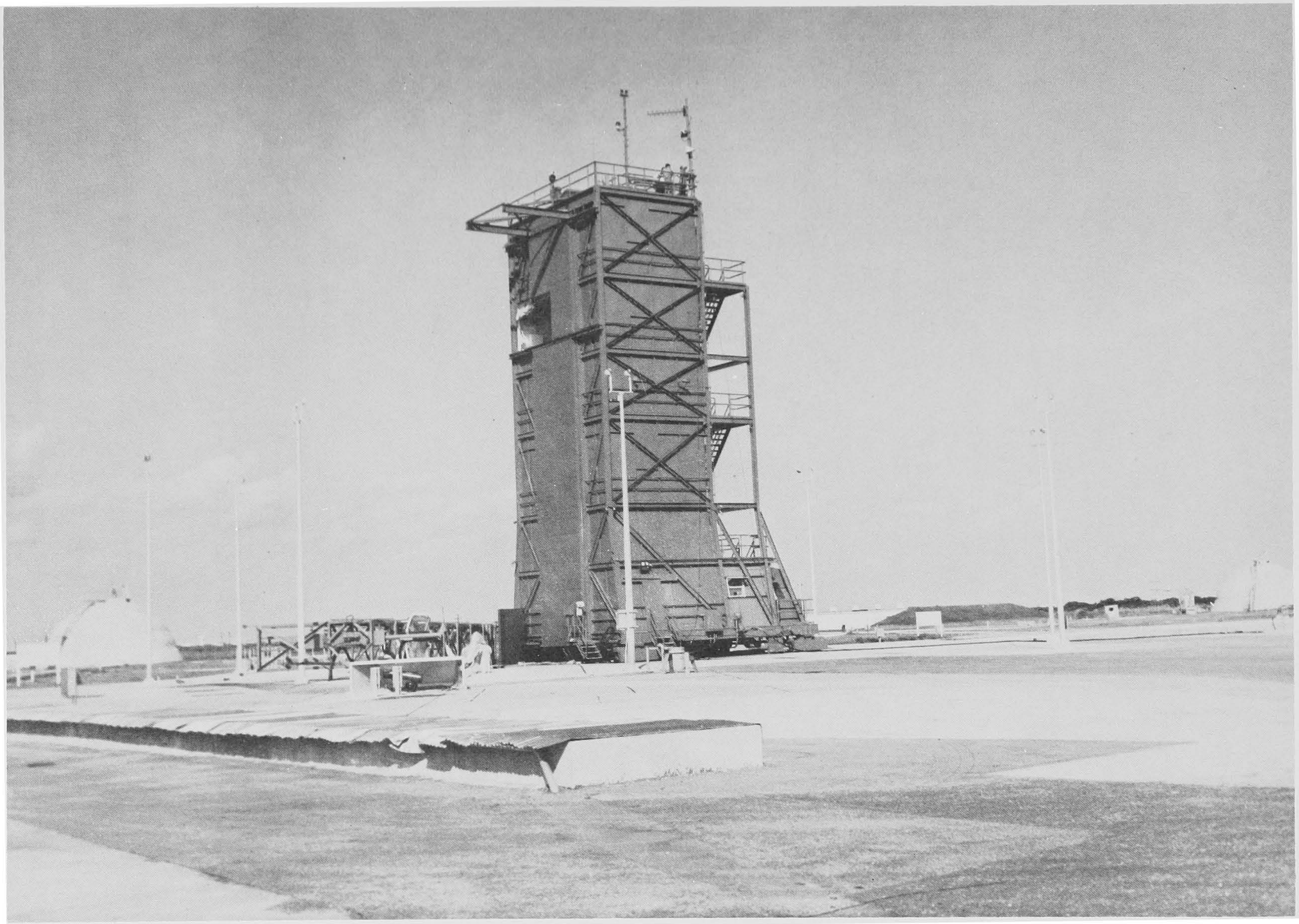
standardization reduced overall construction time by about one-third.

A feature common to Missile Assembly Buildings is their overhead cranes for handling missiles, missile stages and heavy components. These cranes vary widely in their capacity and number, within the several MABs, but they are common to all. Since no interference with the "clear area" height and width of the main hangar-bay could be tolerated, the cranes themselves were a novel departure from normal industrial practice. The crane bridges are of a special underslung design, travelling on rails suspended from the roof trusses. Each bridge spans half of the main bay width, and interlocks with another bridge to permit the crane to cover the entire span of the main hangar-bay. As in the case of structural steel for the standardized MAB framework, crane procurement was handled independently of the general construction contract to help speed-up overall progress on each construction project.

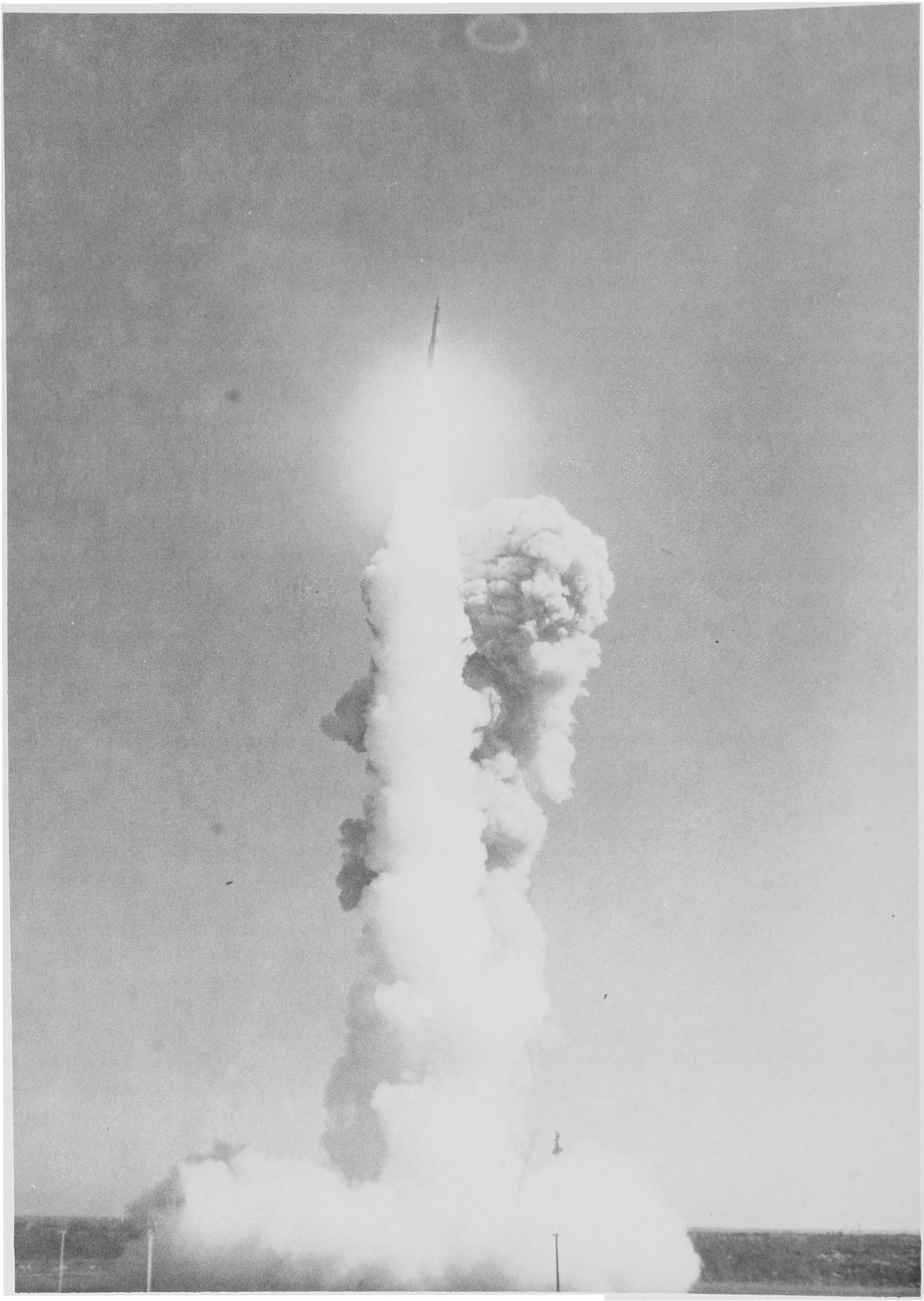
Perhaps the principal construction difficulty encountered by the Corps of Engineers during the IRBM-ICBM era at Cape Canaveral involved the emplacement of utilities to support various launch facilities. Exact requirements for each complex were determined by the missile itself and the proposed operational procedures. In all cases, power, water and instrumentation circuits were required. There were often provisions for liquid oxygen, kerosene, and other liquid fuels; for liquid nitrogen, gaseous nitrogen, helium, or highly compressed air, and for tailored air-conditioning of areas housing delicate electronic gear. Except for power, each of these systems brought its own problems in the course of construction. Primarily they involved meeting construction schedules with respect to piping, tanks and equipment for storage and handling of liquified and compressed gasses. These systems could not be fabricated from stock items, and the short time schedules left minimal margins for manufacture of necessary components. Many of the supporting "functional-systems" for the early missiles were every bit as experimental as the rockets themselves and the Corps successfully proved itself in this new challenge.

Liquid oxygen (Lox) and liquid nitrogen (Lin) provide the temperature extremes that had to be dealt with. Their boiling points are -297 degrees and -320 degrees, respectively. To reduce Lox and Lin evaporation losses, tanks are generally double-jacketed stainless steel vessels. Pressure in the annular space between jackets is evacuated to high vacuum (1/76th of atmospheric pressure) to increase the insulating effect. Additional problems are created by the strong tendency of liquified gasses to cavitate in pumps, valves and orifices, and by the large amount of contraction in piping.

Various inert gasses (nitrogen, helium, and air) are used extensively to maintain pressurization of liquid gas vessels and components of the missile. Operating pressures at the point of application of the inert gasses vary widely, but storage and much of the piping are designed at 6,000 pounds per square inch to reduce the required volume of storage.



Minuteman Service Tower was the first fully enclosed structure of its kind built by Corps at Cape. Others were of steel-framework open Gantry type. Note beehive blockhouses at left and right of photo. Corps built two silos, two flat surface pads for MINUTEMAN.



Air Force Minuteman ICBM flies from vertical underground concrete-and-steel barrel, which gave new definition to the word "silo." Ignition thrust and gust of exhaust put novel "smoke ring" ahead of missile (visible at top of photo).

Handling of gas at this pressure requires careful design of heavy pipes and fittings and extreme care in workmanship during fabrication and construction.

Solid-fueled missiles (MINUTEMAN, POLARIS) simplified all plumbing requirements except for fire-deluge water systems at the launch pad. The Corps of Engineers completed MINUTEMAN's heavy construction requirements in August 1960 at a total cost of about $7 million. This missile presented the first demand for "silo" construction -- the emplacement of two underground firing "barrels", or silos, of 90-foot depth and 26 feet in diameter.

Resting in its silo, MINUTEMAN was surrounded by walls six feet thick, of reinforced concrete. Underground equipment rooms were connected to each launch silo by reinforced concrete cableways. The silos were constructed by the open caisson method. Minuteman's test program also required two flat launch pads -- 116-foot square slabs of reinforced concrete of varying thicknesses -- under which launch equipment rooms were built. Each pad had a 77-foot mobile service tower. The blockhouses for test of this new solid-fueled weapon (which is now over 1000-strong in the Air Force deterrent inventory) were 55 feet in diameter at their bases and 29 feet high -- and in this instance they represented a departure from previous construction methods, in that they were built wholly of reinforced concrete and then covered with sandbags. They took on the external appearance of giant beehives.

The facilities provided by the Corps of Engineers to permit the launching of missiles and space vehicles are naturally underscored here. The construction task, however, does not end when these works are completed.

Before a missile leaves the world's most famous palmetto patch, and while it sits in the sleek aloneness of its countdown, it is under the probing eyes of cameras, radars, cine-theodolites and other tracking devices that "see" everything from its skin temperature to the condition of its multitude of electronic, hypergolic, metallic veins. Once off the ground, the missile (or space booster) will itself transmit an amazing array of data about its performance and its health to thirsty telemetry receivers. A thorough description of all such equipment and the construction support it requires would rate a major discourse, a history of its own. In fact, with respect to missile tracking facilities, the Corps of Engineers alone has built everything from periscope mounts to on-site parking lots, including complex buildings that house generators, radars, a multitude of electronic gear. To interconnect the launching, tracking and control mechanisms at Cape Canaveral there are today intricate networks of power and communication cables. Virtually all communication cabling and much of the power cable is underground, carried in about 400 miles of duct buried within an area of about 9 square miles on the Cape proper. (This excludes Merritt Island, Titan III, the Apollo Saturn complexes.)

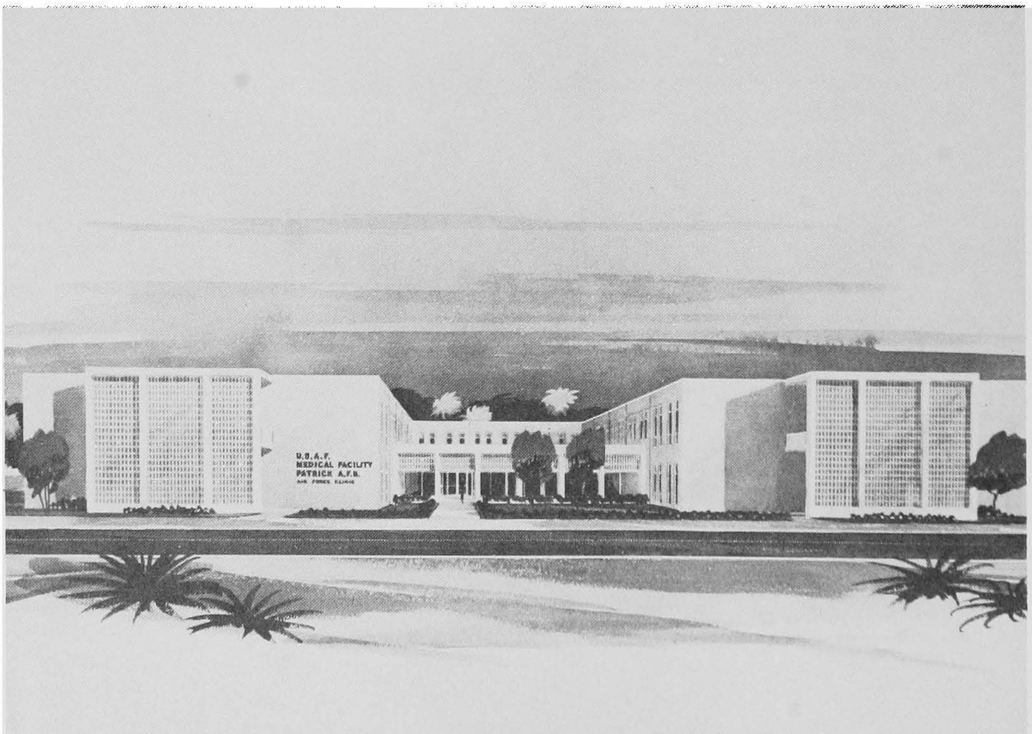
The final step in the history of any missile/space launch and its end performance, is an analysis of the data collected during its flight. A remarkable technical laboratory -- built in three phases between 1955-59 to assure its accommodation to the rapidly moving space age it would serve -- was constructed at Patrick Air Force Base to effect flight analyses. Except for the runways, it is today the most prominent feature at Patrick when seen either from the air or from main Highway A-1-A on which it fronts. Costing $7.3 million, and with a floor area of 455,000 square feet including utility space, the Tech Lab is one of the largest structures in central Florida.

The building is completely air-conditioned, walled intermittently with glass building-block panels which admit natural light to supplement the latest in artificial interior lighting. Its essential structural features, including frame and floors, are of steel and reinforced concrete designed to withstand hurricane-force winds. Here, all of the airborne and spaceborne secrets of man's ballistic hardware arrive electronically to be collected, collated and presented graphically to man on the ground. As this edifice came together, the Corps of Engineers managed to also give it an architectural attractiveness by simple and inexpensive treatment of the three principle entrances that face the Atlantic Ocean, using columns to break the long horizontal lines of this strictly-business space-age structure.

Later projects at Patrick AFB would of course be overshadowed by the coming construction boom at Cape Canaveral and the NASA Space Center, but the Corps of Engineers continued design and construction supervision for Patrick AFB facilities throughout the 1960s in a total amount of about $8 million. Modern dormitories for airmen replaced temporary World War II barracks; two modern three-story office buildings were built to house Missile Test Center headquarters activities; new Commissary and Chapel buildings were built in the Capehart Housing area, and a new 100-bed Air Force medical center and other support facilities rounded out the Corps of Engineers effort at Patrick AFB proper.

Giant Technical Laboratory built by Corps for Air Force at Patrick AFB. Building houses computer complex and related instrumentation and is main hub of data collection for Eastern Test Range.

Shown here is one of two three-story Headquarters buildings built by Corps of Engineers at Patrick AFB in early 1960s.



One of Corps' construction highlights at Patrick AFB was new $2.6 million hospital and medical center, shown here in artist's initial concept.

CHAPTER III

A NEW DISTRICT IS BORN

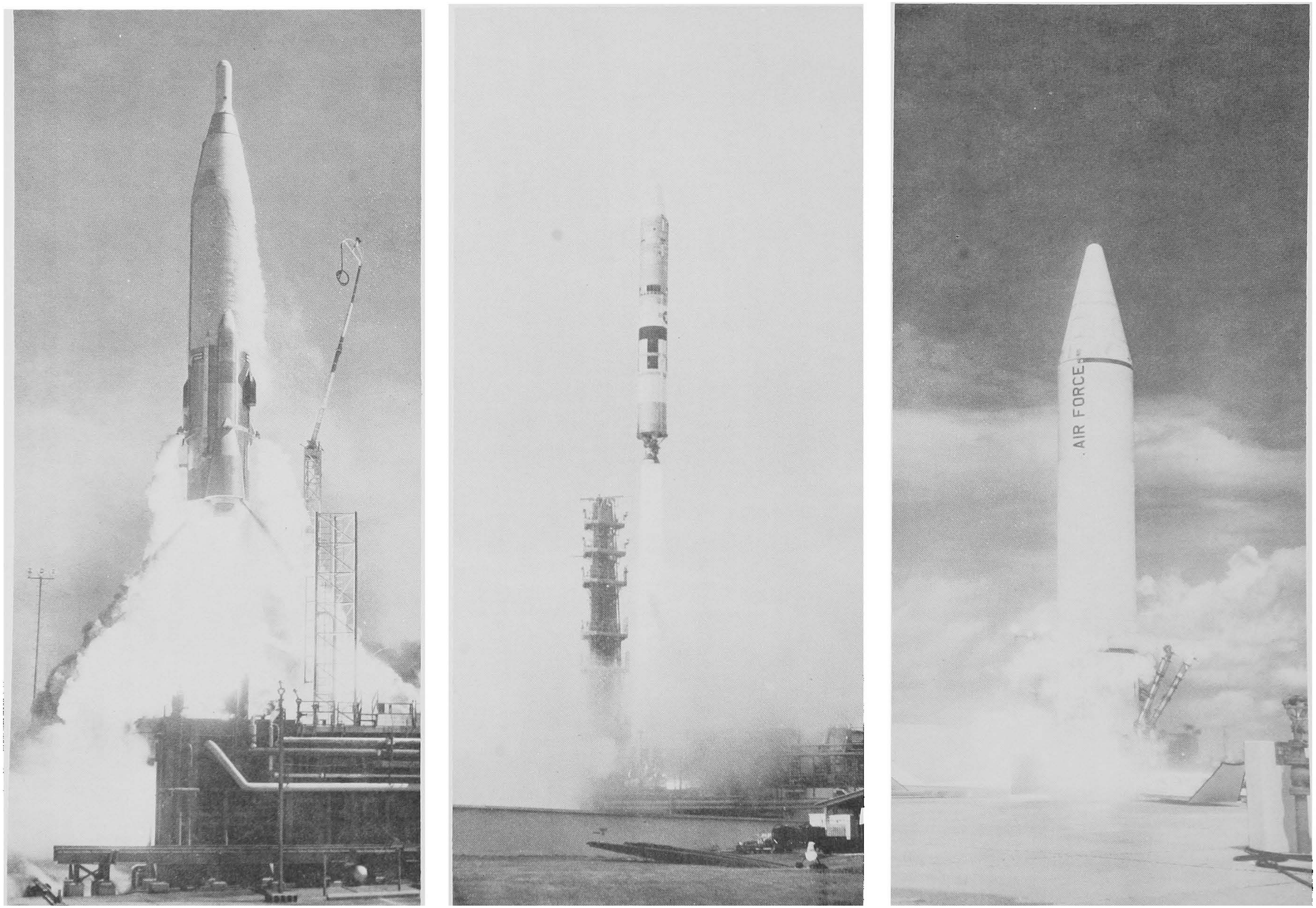
We have reached an appropriate point here to mention that the Corps of Engineers, among all government agencies, is most notably lacking in any tendency to "homestead" or construct expanding personnel empires on any permanent basis. It traditionally operates to meet engineering and construction needs, its staffing remains elastic throughout the tenure of any long-term "on location" situation, and will expand and contract within a given area of assignment to meet enlarged or shrinking commitments until the job in-toto had been done.

Because of the Corps' national network of Division and District offices, it can rapidly troubleshoot on a "project" basis, generate fast expansion against peak loads, slacken and retract in size to match demand, and expand again readily. Wherever possible it becomes resident in existing public or federal space, leases its administrative and operating locations as required, retains organizational flexibility by actually "owning" nothing on-scene.

Throughout the thirteen-year span from 1950 to 1963, the Patrick Area Office had been an adequate operating arm and action agency at Cape Canaveral for the Jacksonville District, Corps of Engineers. Management, administration and supervision of construction on major launch and support structures for such programs as Thor, Redstone, Vanguard, Pershing, Jupiter, Atlas, Polaris, Minuteman, Titan and Saturn I had run smoothly under this arrangement. All of the new and exacting design and engineering criteria had been met, as had the tight deadline dates for these priority military and space test installations.

But in January 1963, when the massive construction requirements for NASA's Apollo launch series and the Air Force Titan III program were outlined, the Chief of Engineers reached the conclusion that the highest level of support and administration could best be provided if a District Engineer Office were established at Canaveral, fully geared to meet the special needs of space-launch design and construction and to properly discharge the supervisory responsibility over ever-more-precise specifications.

Accordingly, the Canaveral District was established on May 1, 1963, with Colonel G. A. Finley, already with the Canaveral operation since March as Assistant District Engineer, Jacksonville District, assigned as District Engineer. Since his March arrival at Canaveral, Colonel Finley had busied himself with the pre-District transitions of scouting and interviewing key people for positions within the new District organization. In rented office space within the then-new City of Cape



Air Force workhorses Atlas (left) and Titan II (center) are ICBM missiles.
At right is launch of Jupiter, an intermediate range ballistic missile.

Canaveral, Finley quietly undertook the task of building an Engineer District which he knew was forthcoming. His job involved scouring the country for those talents and capacities that would best suit the new space construction requirements that confronted him on this new horizon.

To accommodate the organization Col. Finley was putting together, the Corps picked a site for a new District Headquarters building on Merritt Island, and a lease-build contract with Eastern Diversified of Orlando (using Gee and Jensen as design architects and engineers) was awarded -- under criteria developed and prepared by the Jacksonville District, which was then still the prime contracting authority for the Canaveral area.

The new Headquarters structure, a two story "H" shaped office building, would have 58,000 square feet of administrative floor space, plus a motor pool, service garages, a complete printing plant, security fencing, and all utilities normal to a firstclass engineering executive Headquarters. After operating out of "shoeboxes and shacks" at the Cape since 1950, the Corps never had it so good.

But they didn't have it yet, and Col. Finley's new people were in various stages of en-route, arrival, partially recruited, wholly signed up or still in process. Additional interim space (prior to completion of the new Headquarters) became essential. The new District's Construction Division (about 50 people) occupied newly acquired NASA land (north of the original Cape Canaveral boundary) on April 1, 1963, in a temporary location rather ornately titled Building No. K8-988.

A contingent of the Personnel Office from the Jacksonville District was removed as an entity to the new Canaveral District build-up and took over the old Patrick Area Office Building (510) at Patrick AFB. The Engineering Division continued to function as an integral part of the Jacksonville District Office -- on key matters of design and new construction for NASA and the Air Force -- until their move to the Canaveral District proper on 8 July 1963.

Through all of this shifting and snugging-up -- so typical of any major move, either government or corporate -- it was necessary that design, engineering and contracting of new work proceed without interruption. This was also true of matters relating to the construction of facilities already under contract. Naturally, numerous problems were encountered in this rather major transition, but care was taken that no delays or pitfalls would occur within the critical Space-related activities which were, in themselves, responsible for the new District's birth.

Refined personnel recruiting continued. Key employees of the Patrick Area Office were offered positions within the new District organization prior to outside personnel procurement. Beyond this, 150 employees from the Jacksonville District were transferred to the new

New Canaveral District, Corps of Engineers, occupied this busy Headquarters, constructed under a lease-build arrangement on Merritt Island, south of NASA's Kennedy Space Center operations.

Canaveral operation, many of them from the Jacksonville Engineering Division and others from the Office of Counsel, Administrative Services, Supply and Personnel. In its initial build-up, the Canaveral District also drew on personnel from many Divisions and Districts throughout the United States, and even managed to proselyte the Office, Chief of Engineers, Washington, D. C. for people aware of the challenges involved. A total of 17 people transferred from the then-active Titan II project at Wichita, Kansas, and an international flavor was added with a substantial number of overseas returnees from Turkey, Korea, Italy, Greenland, Vietnam, Hawaii, Alaska, the Panama Canal Zone and elsewhere.

Col. Finley put his organization together with selectivity and discrimination, and it came together from just about everywhere.

With the activation of his new Canaveral District on 1 May 1963 an appropriate ceremony was held at the construction site of the new "lease-build" Headquarters building, with a rousing turnout of Army, Navy, Air Force, NASA and civilian dignitaries from local, state and national levels of commerce, business, politics and the professions. And somebody had it "engineered" to where most of them brought their wives.

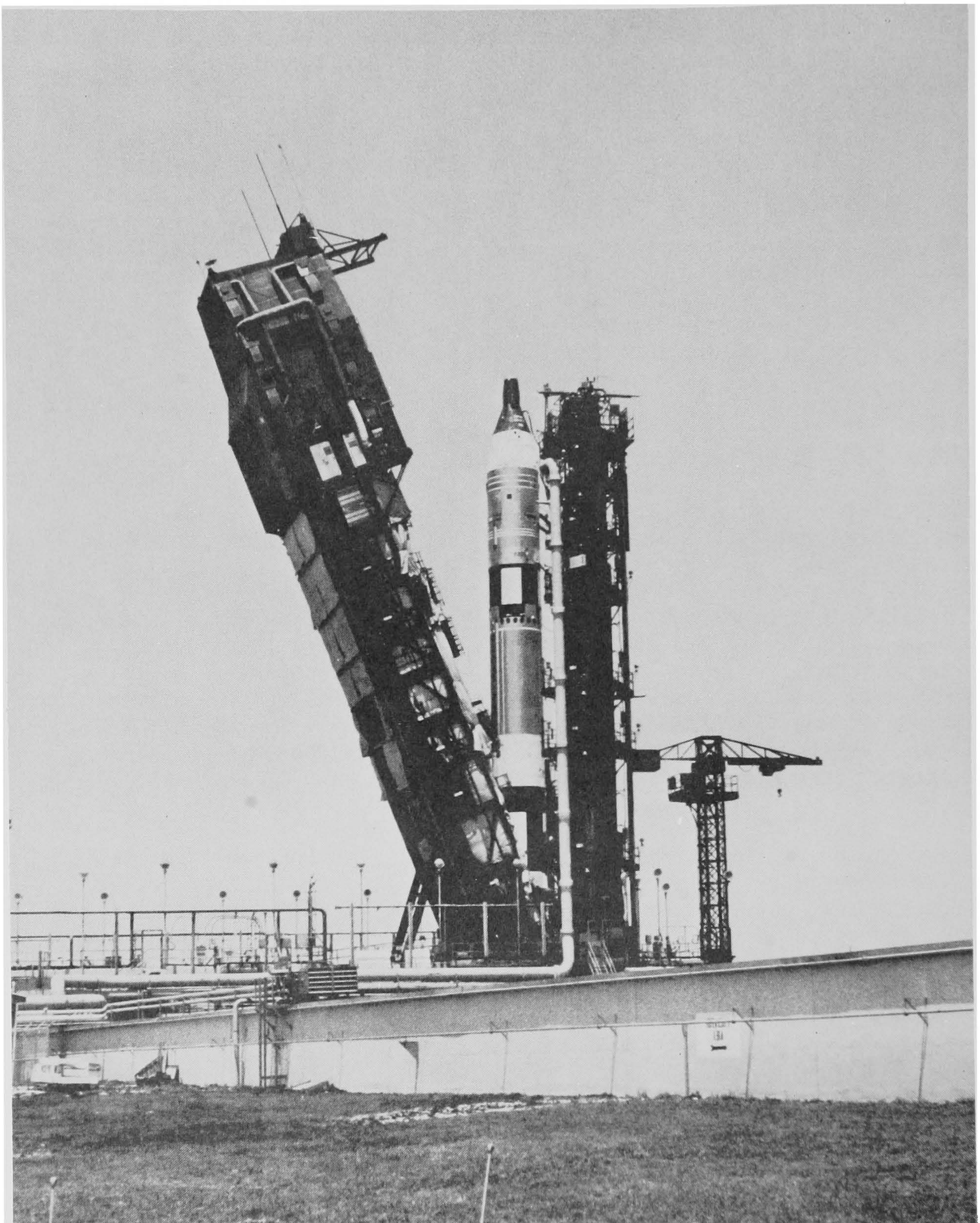
The three "overnight arrivals" who had undertaken Bumper's first launch pad in 1950, had now grown to a force of more than 540, operating from four on-site field locations and a leased Headquarters building on Merritt Island (1 July 1963), south of NASA's burgeoning Space Center. Their size would ultimately reach 604 in July 1965, including a contingent assigned under the "Rotational Training Program for Engineer Officers" (see Appendix C).

Although tailored primarily to meet the Apollo and Titan III programs on the near horizon, the new Canaveral District had inherited 90 going projects valued at better than $85 million from its predecessor organization, and of these the prime immediacy involved completion of the conversion of Pad 19 (Titan I) for delivery to NASA by August 1963 as a ready Titan II launch facility for the two-man Gemini flight series that would send a total of 20 astronauts into near space for upgraded missions of space docking, space-walks and related advanced effort.

On the surface, this conversion job was simple enough to state: take this ready-made Titan I facility and modify it to handle the Titan II booster for Gemini. But this simple statement masked what was to become one of the most ingenious face-lifting jobs of the space age.

Consider:

a. Titan I's fuel was liquid oxygen and kerosene. Titan II would use a hypergolic fuel, which meant a completely new fueling system for the launch complex.



One of first major projects for new Canaveral District was completion of conversion of Launch Complex 19 from Titan I to Titan II facility for NASA's Gemini Program. Here Titan II Gemini vehicle is readied for space mission at newly modified facility.

b. Titan I stood 98 feet tall, a giant ICBM with the specific job of hauling a nuclear warhead on a ballistic arc and releasing it over a distant target. Titan II with its Gemini spacecraft measured 108 feet in height, which called for more than merely raising the umbilical tower.

c. Gemini required not only an improved man-rated booster, but also a "white room" at the top of the erector, or service structure, for work on the booster's upper stage and on the spacecraft itself. This meant lengthening the erector by 28 feet, but (AND THIS WAS A CONSIDERABLE BUT) the taller tower could weigh no more than the existing one.

What this amounted to was chopping off the top 19 feet of the erector and replacing it with a four-story building, plus an elevator and crane at its top -- but without adding weight and without weakening the structure.

Most of the answer lay in new and extensive uses of aluminum. So critical was the weight factor, particularly in construction of the 47-foot-high white room, that each piece was pre-weighed before assembly -- down to and including the rivets.

Aircraft-type construction was adopted, using a stressed-skin principle. This, in simplified terms, meant that the skin would take part of the stress of the structural framework; in essence, the skin or exterior surface, becomes an integral part of the structure.

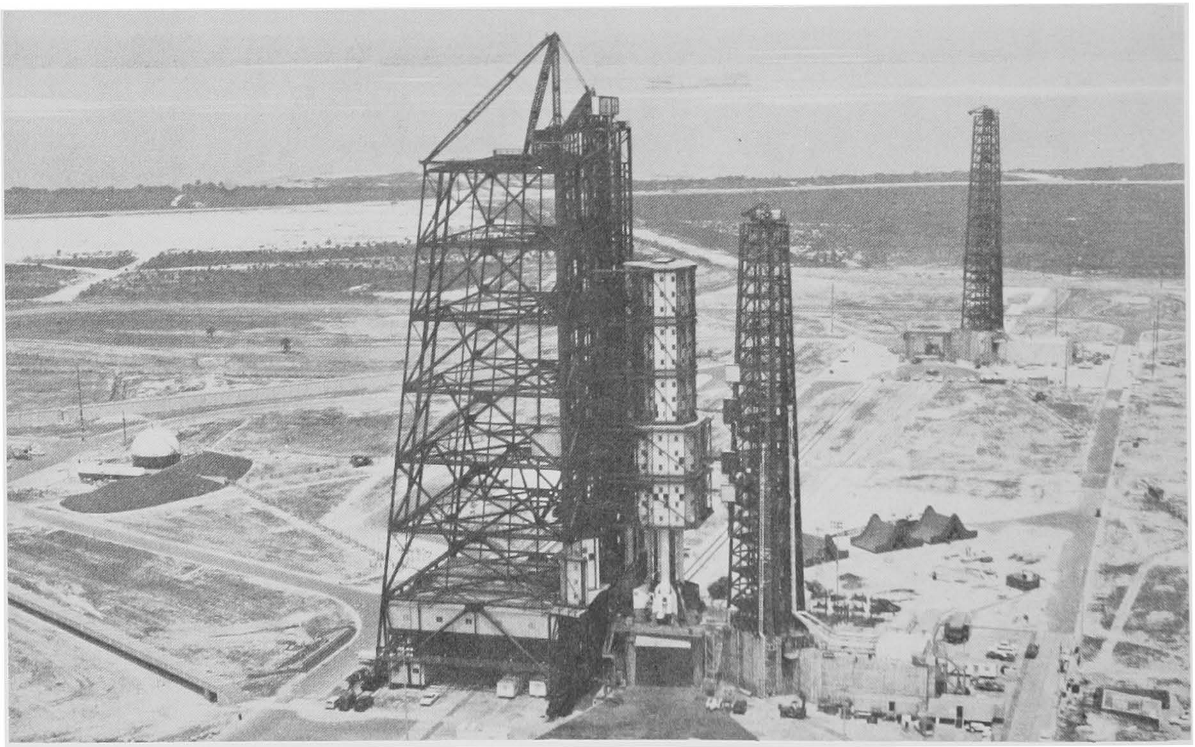
Even the five-ton capacity crane atop the white room, used to hoist and emplace the Gemini spacecraft, was fashioned of aluminum and would ride on aluminum rails. The rolling door enclosing the white room was also made of aluminum, and the metal was used in modifications on the hydraulic work platforms which provided access to the launch vehicle.

A new elevator was built of steel, but to minimize weight it was designed to operate on one rail rather than two.

When work was completed, the erector had grown from 110 feet to 138, including the 25-foot square, 47-foot high white room, and the fine balance of leverage had been maintained. Initial cost of Pad 19 and modifications for Gemini exceeded $4 million.

Also underway at this time at the extreme north end of Cape Canaveral proper was Complex 37 -- with pads 37-A and 37-B, the largest launch pads in the world up to their day. Due for late summer (1963) delivery at a projected cost of $40.5 million, this complex would launch Saturn 1B on vehicle-experiment and checkout flights and related space R & D missions important to the later follow-on Apollo Saturn 5 flights.

Occupying about 120 acres of formerly swampy coastal land, Complex 37 had been securely anchored by a forced sand process called Vibroflotation, a patented method for compacting sandy soil to pre-settle



Upper view shows launch complex 37 as completed by Corps for NASA in late summer 1963. Lower photo shows Saturn test rocket erected on launch pedestal, its upper portions enclosed in the steel compartments of service tower which permit vehicle checkout in a protected environment.

a given volume with vibratory forces far greater than those caused by actual loadings. These forces rearrange the sand particles into a dense mass capable of supporting the heaviest dynamic surface loads yet conceived.

To provide for this latest launching complex, 220 thousand yards of sand had to be moved. This is said to be enough material to build a man-made beach thirty feet wide by forty miles long -- with maybe enough sand left over for an hourglass or two.

Two thousand tons of steel rods were required to reinforce the concrete foundations. It is said (again) that with this much steel, the nation's seventh largest city -- Houston -- could be completely encircled with a three-strand fence of one-inch diameter wire. (With maybe enough left over for a crowbar?)

The 328-foot high service tower at Complex 37 was reputed to be the biggest thing on wheels at that time. It weighed 10,000,000 pounds.

The Corps of Engineers brought Saturn 1B's new Complex 37 in on time.

As it faced its challenging future, the new Canaveral District, Corps of Engineers, took some comfort from the thirteen years of Cape experience which clearly would enable it to foresee and plan for major problem areas. Some of the more outstanding ones were listed:

a. The Pressure of Time

Nearly every project undertaken in the past had been done in the shortest possible time so as not to delay the missile and space endeavors. From the moment a using agency (Army, Navy, Air Force, NASA) presented its basic criteria and authorized the resultant construction, a deadline date for completion of the work and for intermediate joint occupancy of component parts had been established. The Corps then negotiated and awarded a contract to an Architect-Engineer for preparation of construction plans and specifications. Arrival of plans was immediately followed by advertising of the work project, acceptance of bids from responsible contractors and the award of a contract to the lowest bidder. Specifications required work to be completed by a certain time, with established dollar penalties against the contractor for each day needed to complete beyond the contract date. This time pressure -- together with in-process changes required in method and/or procedure -- had invariably required contractors to work their people on an overtime basis.

Since all of the work had been of a unique nature on previously unparalleled research and development space projects, many changes were invariably introduced by using agencies as work progressed. Most of the extra work thus engendered had to be compressed into the previously established completion time, in order that national overall launch and

operational demands would be met.

b. Labor

An adequate labor force had not been available in the beginning at Cape Canaveral, and the tediously established stable supply would now need big transfusions from all over the country. Even then, certain skilled labor would remain in continuing short-supply. To correct this situation, capable personnel in allied tasks would be trained on-the-job to perform certain work -- principally such tasks as cable splicing, instrumentation and communications work, intricate control installation jobs and other technical precision requirements.

c. Materials

Manufactured products such as copper wire, power and instrumentation cable, transformers, oil circuit breakers, generators and other equipment had invariably been in short supply. Priority ratings would be established by the Government and special expediting actions evolved to insure early delivery on such long-load items.

d. Soil Conditions

The water table at Cape Canaveral had presented problems on each past project, and in the now-proposed areas of heavy construction it would be at best about three feet below the ground surface, Also, much of the work would be done on land dredged from a brackish river. This high water level meant that nearly all of the below-ground conduct lines had to be dewatered, thereby adding to time and cost. Nearly all of the area was sand, and heavy load-bearing structures required extensive piling and/or special soil compaction. In addition, the corrosive effect of the soil demanded special protective measures such as cathodic protection, and special surface treatment. The Corps had long ago learned that the sands of Canaveral could be cajoled, but seldom changed for keeps without strenuous effort.

e. Atmospheric Conditions

Being so close to the ocean, and occupying what was already ranked by professional surveys as the most corrosive coast in the world, the Canaveral sites had from the beginning required special precautions to alienate corrosion of exposed items. Special finishes were required for steel structures, electrical enclosures were specified to be of cast metal, much of the power distribution system had been (and would continue to be) installed underground, and the bulk of the above-ground systems used aluminum-encased cables with neoprene jackets for distribution systems mounted on poles.

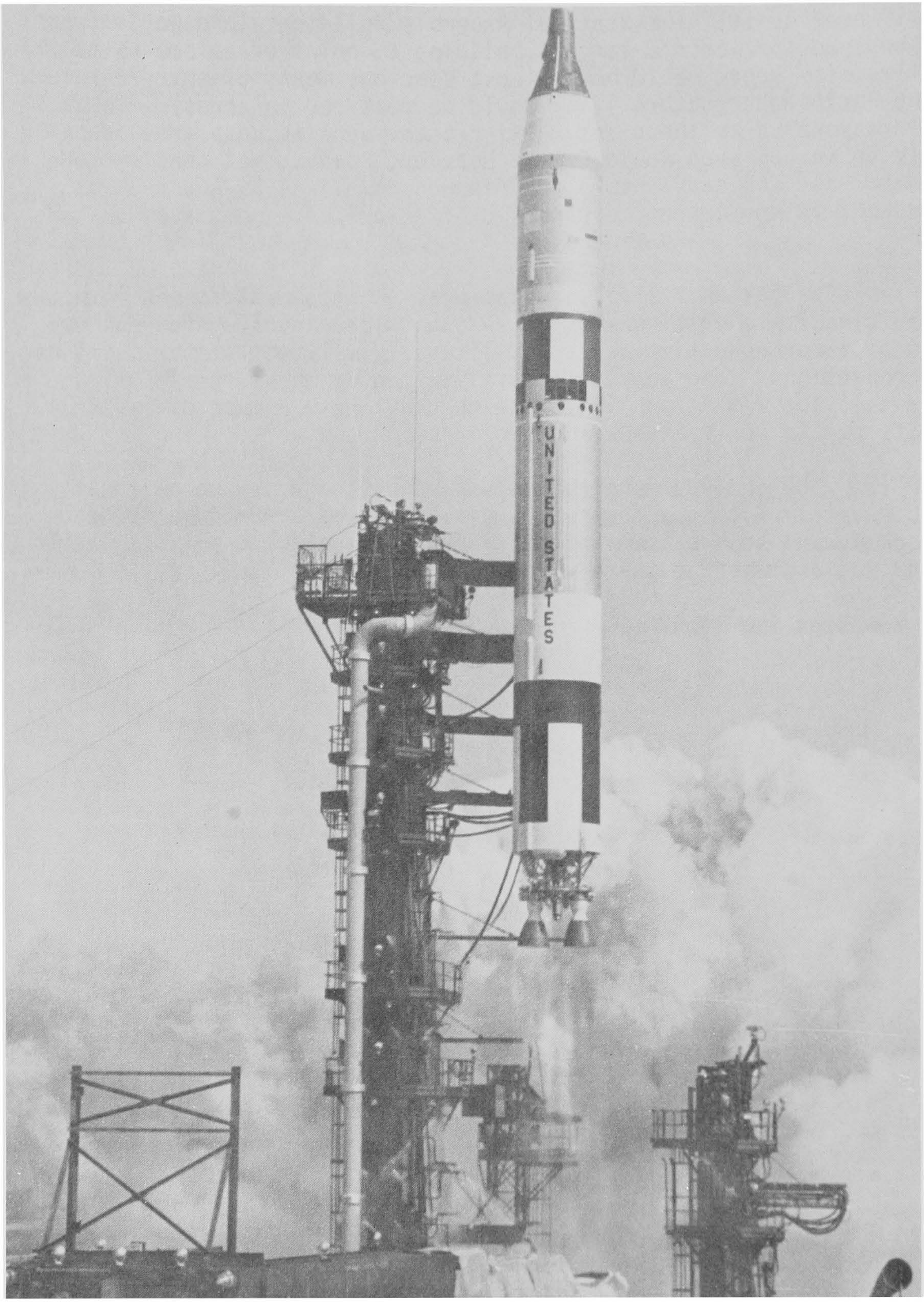
The thirteen-year experience would be brought fully to bear, but the new Canaveral District knew that its confrontations would indeed be immense. Much of the work would wind up as the "largest" or the

"first" ever built. The Vertical Assembly Building alone would (when finished) be the world's largest building in point of volume up to its time; its doors would be the most spacious means of entry/egress on any enclosed structure (they would be measured in acres). The crawlerway to carry the giant multi-staged space rockets from assembly to launch area would be the heaviest roadbed yet constructed anywhere, and the pads themselves (launch complexes 39-A and 39-B) would contain the largest expanses of fire-brick yet emplaced on earth.

Instrumentation systems, operational intercommunications networks, closed circuit television systems -- each would involve hundreds of miles of interconnecting wires and literally millions of terminations and connections. The testing and validation of these systems alone would call for a vast and intricate checkout net, a maze of wiring all its own to verify the virtues of a sister network.

From 1963 onward, mankind's oldest question would be alive at the Canaveral District, Corps of Engineers. There would be no need to look upward on the lofty night. The question, with all its overtones, would always be there.

How high the moon?



First U.S. two-man flight in Gemini program made three orbits of earth on 23 March 1965. Lift-off from Launch Complex 19.

CHAPTER IV

THE BIGGEST AND THE MOST

From the birth of NASA in October 1958, the U. S. Army Corps of Engineers served as its supervisory design and construction agent in the Cape Kennedy area.

(The name of Cape Canaveral was changed by presidential announcement -- a TV broadcast of 28 November 1963 -- with the sanction of the Board of Geographic Names. The Board then confirmed the change in Decision List No. 6303 (September through December 1963) published in the spring of 1964. Executive Order No. 11129, dated 29 November 1963 decreed that NASA and the Air Force Launch Facilities on Merritt Island and the Cape would thereafter be known as the John F. Kennedy Space Center. The Air Force then changed the name of Cape Canaveral Missile Test Annex to Cape Kennedy Air Force Station, and NASA changed its Merritt Island Launch Area (MILA) to John F. Kennedy Space Center, NASA.)

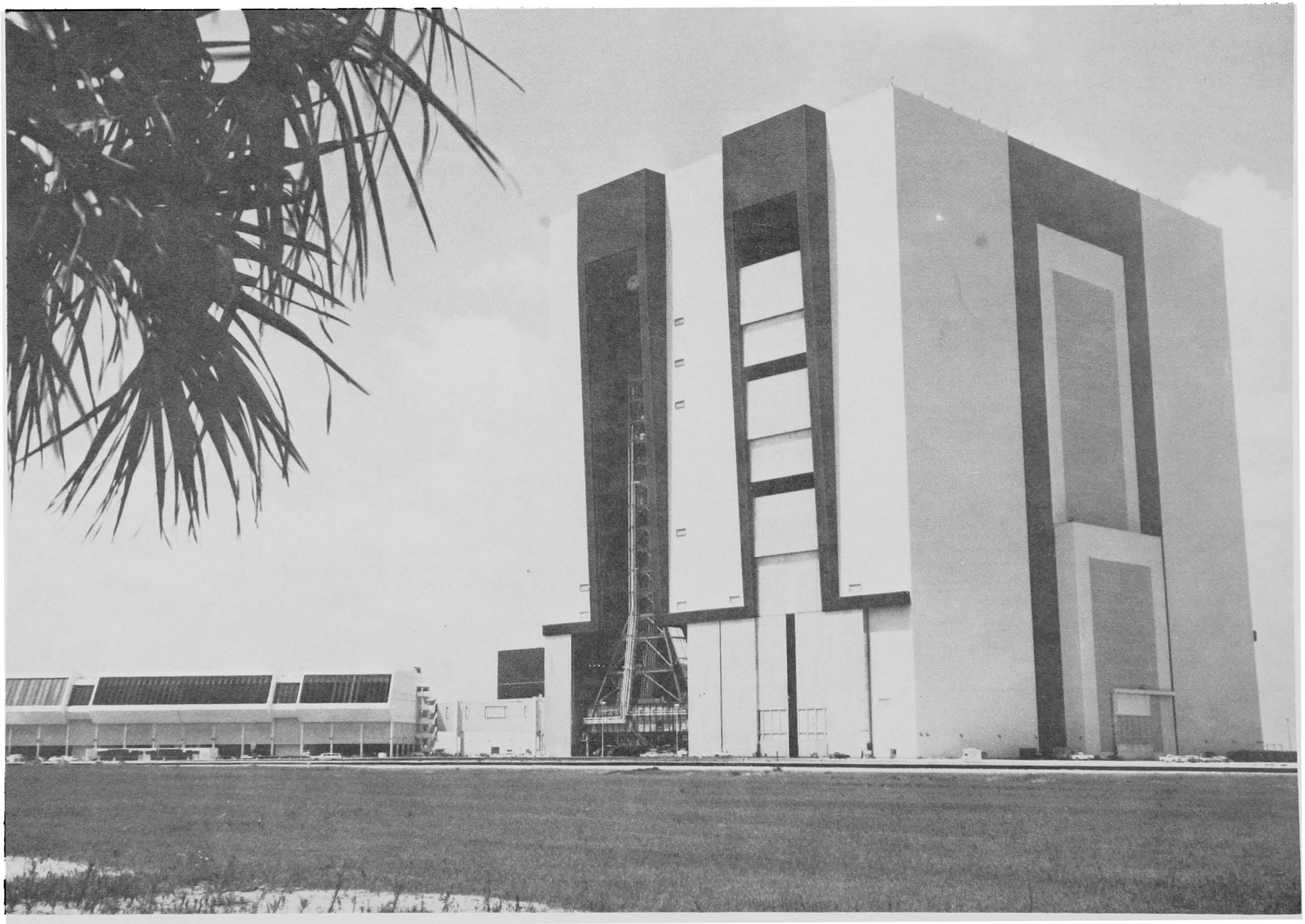
Through its Canaveral District, as of May 1963, and previously through its Jacksonville District via the Patrick Area Office, the Corps was NASA's prime mover in the engineering and construction of both Apollo Launch Complex 39 and the Industrial Area supporting it at John F. Kennedy Space Center, as well as Saturn Launch Complexes 34 and 37 and other launch sites at Cape Kennedy.

This chapter is concerned primarily with the major facilities at Launch Complex 39 (which history will no doubt record as one of mankind's major construction achievements). The Saturn V Complex 39 stretches inland from the Atlantic Ocean across four miles of what, until 1963, was a land of intermittent marshes and sand scrub growth. In less than four years it was transformed and transfigured into a vast operational space-launch complex (the word "spaceport" has often been loosely used in this context, since it implies landing -- or docking, in the naval sense -- and the John F. Kennedy Space Center has not yet incorporated these functions).

The facilities detailed in this Chapter will include the Vehicle Assembly Building, a structure large enough to handle the simultaneous erection of four of the 363-foot-tall Apollo-Saturn V launch vehicles; a Launch Control Center with four giant "firing rooms" for monitoring and controlling all checkout and launch operations on the Saturn V; three 46-story tall Mobile Launchers, of 10.5 million pounds each, on which the vehicles are erected, transported and launched; a forty-story Mobile Service Structure designed to permit work on vehicles at the launch pads; two Transporters for moving the Mobile Launchers and

Vehicle Assembly Building dominates moon Launch Complex 39 at NASA's Kennedy Space Center. Towers at left are Mobile Launchers, on which the Apollo-Saturn V will be erected in the VAB and then be taken over the Crawlerway (right of center) to the launch pads in the background. Dock area, where rocket stages arrive, is at right.

Handsome marker at Kennedy Space Center's Complex 39 salutes the work of the Corps of Engineers and its contractors for the outstanding civil engineering feat of 1966.



Vehicle Assembly Building and Launch Control Center (left) in completed form.

Service Structure; a Crawlerway road on which the transporters travel; two launch pads, capable of withstanding 7.5 million pounds of thrust from the Saturn V engines; and the communications and electronics systems which link this entire complex of space-age engineering together as an integrated whole.

Most of the detailed design work and all of the construction which made Launch Complex 39 what it is today were performed by architect-engineer and construction contractors from private industry under contracts awarded, administered and supervised by the Corps of Engineers or by NASA directly. Their mutual efforts and final successes were recognized in 1966 when the American Society of Civil Engineers selected the complex and its family of related works as the outstanding civil engineering achievement of the year.

From this point on, for reader convenience, the Chapter will carry sub-heads (as per index) to facilitate ready reference.

VEHICLE ASSEMBLY BUILDING (VAB)

With an enclosed area of 129,482,000 cubic feet, the Vehicle Assembly Building at Complex 39 falls about 14 million cubic feet short of two Pentagon Buildings. It's volume has been more closely matched by adding the Pentagon in Washington to the Merchandise Mart in Chicago. When built (it was completed 31 August 1966), the VAB was the then largest building in the world. It has since been surpassed by the supersonic jet transport (SST) assembly building in Everett, Washington, which contains 160,000,000 cubic feet.

The VAB composes two prime sections, a Low Bay where individual rocket stages are received and checked out in eight work areas; and a High Bay, with four assembly areas where the rocket stages are erected and mated with the spacecraft, and where initial pre-launch checkouts are accomplished.

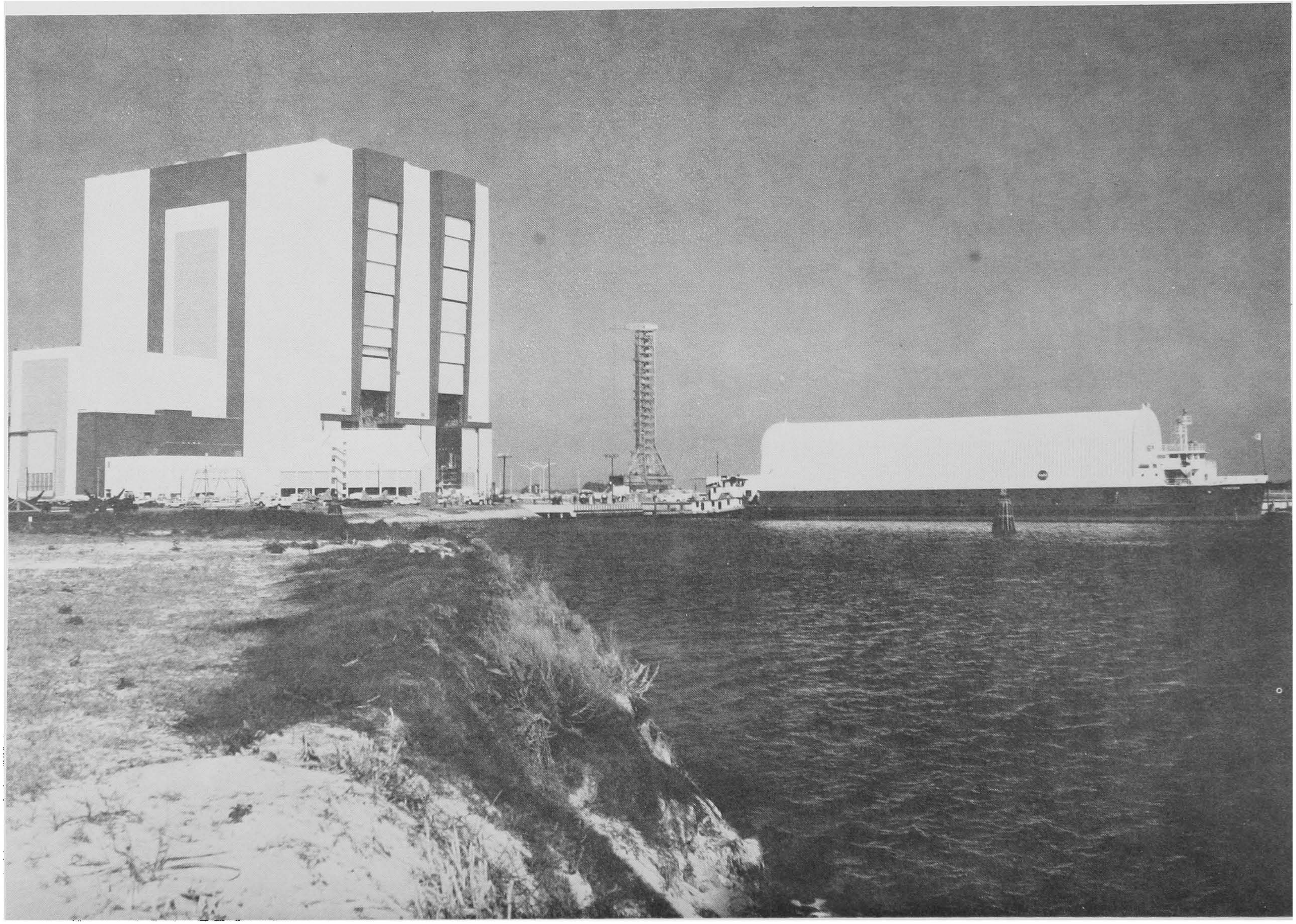
Dimensionally, the VAB is 525 feet 10 inches tall; 716 feet 6 inches long; and 518 feet wide. The building covers about 7.5 acres (343,500 square feet to be exact).

The Canaveral District, Corps of Engineers, knows what it takes to build something this massive:

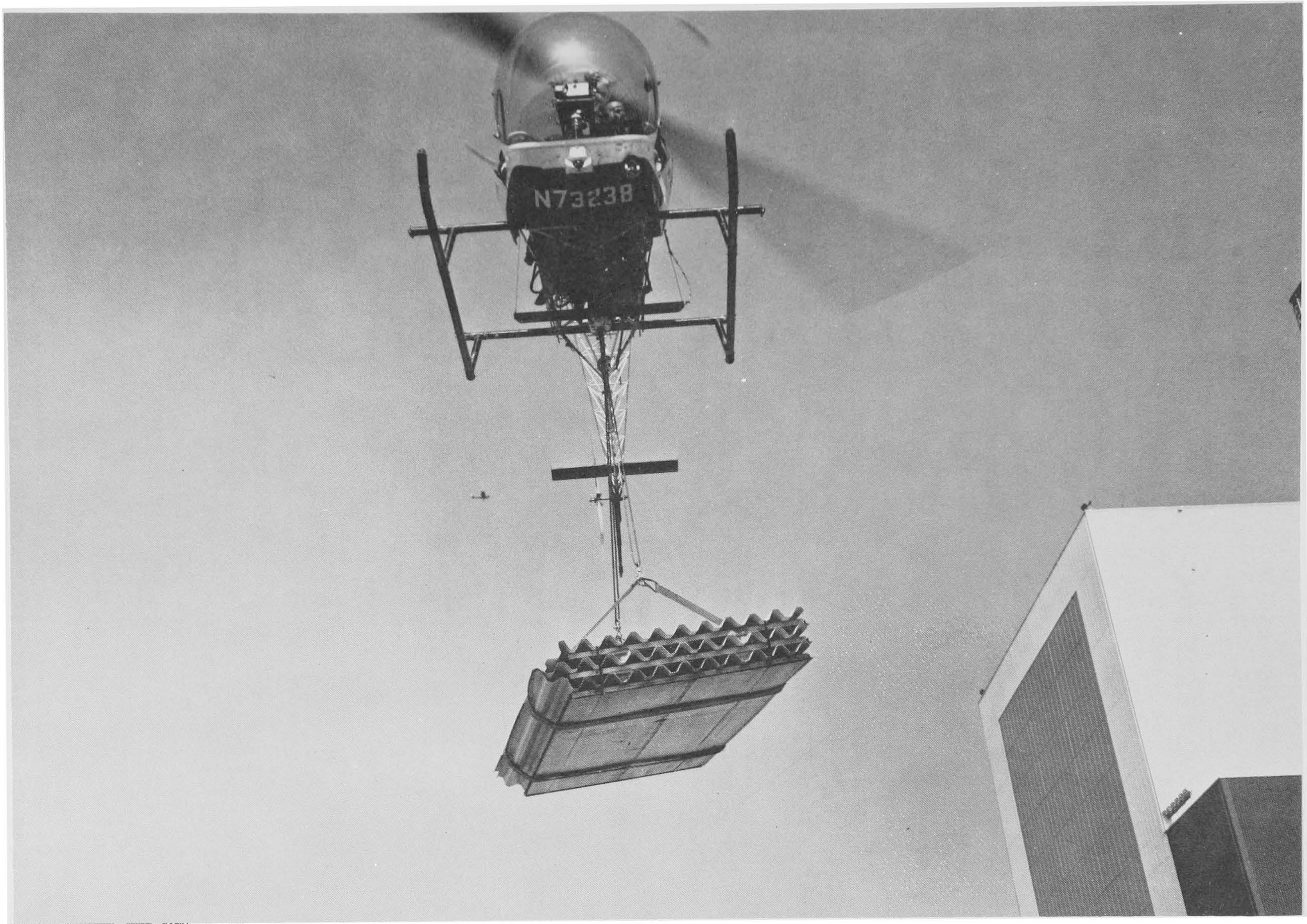
a. $117,000,000.

b. 98,590 tons of steel (enough for 30,000 standard American Passenger cars).

c. 65,000 cubic yards of concrete (all in pile capping, main floor



NASA barge arrives at Complex 39 to deliver a stage of Saturn V.



VAB construction brought on ingenious work methods. Here a helicopter lifts siding to building's upper levels. Construction of the 129 million cubic-foot VAB was completed at a cost of $117,000,000.

slab and interior floors).

d. An exterior surface (excluding doors) of 1,155,500 square feet in insulated aluminum panels, 70,000 square feet in plastic panels.

e. A foundation of 4,225 steel pipe pilings of 16-inch diameter, driven an average 160 feet deep to rock. (This would lay a 16-inch pipeline from Washington to Philadelphia -- 123 miles direct distance).

There are other interesting statistics about this big box where moonrockets come together. It has 10,000 tons of air conditioning (as with 3,000 3-bedroom, 2-bath homes). Enough steel for over one and a half Empire State buildings. In the VAB's skeleton alone there are 60,000 tons of structural steel, knitted and fastened with 1,000,000 high-strength bolts.

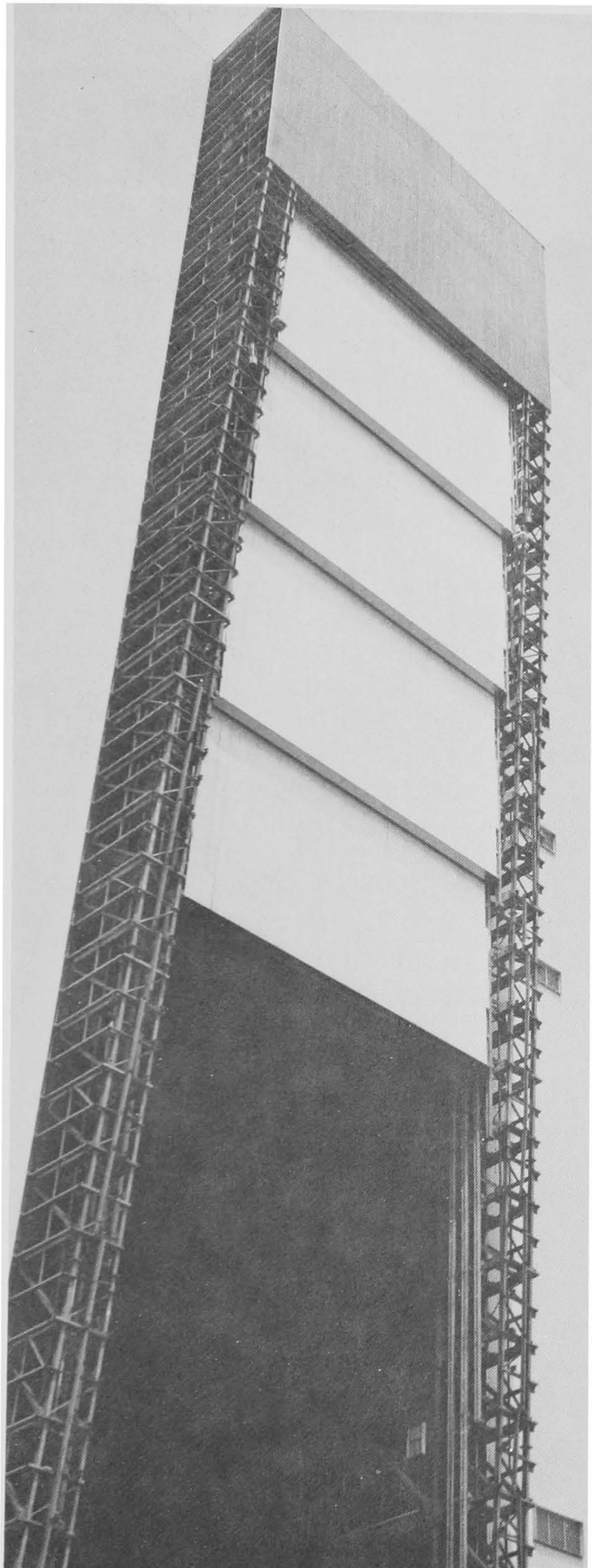
But let us come back down to earth.

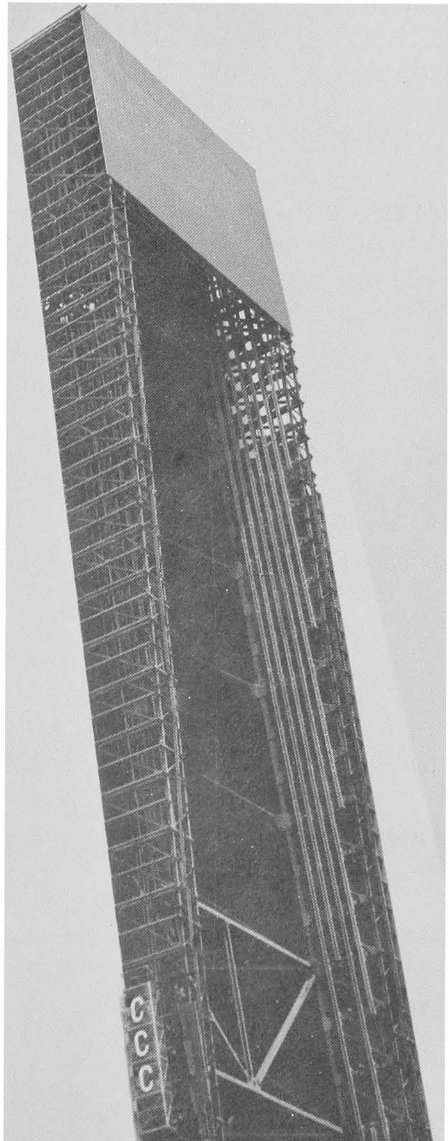
After the Corps of Engineers had cleared and grubbed the Merritt Island wastelands to provide the site, 1.5 million cubic yards of soil were deposited to raise the construction bed to seven feet above sea level. This fill came from an access channel dug from the north end of the Banana River to the VAB area, a channel now used to transport the first stage of Saturn V to an unloading ramp at the VAB.

The VAB site was found to be underlain with sand and compacted shell in the upper 30 to 40 feet, with about 80 feet of compressible silts and clays immediately below. At about 120 feet down lay a 3-foot limestone shelf, almost uniformly spread through the entire area. Below this came stiff clay and silt and finally limestone bedrock at 160 feet down.

With its 4,225 piles (674,000 linear feet in all) driven to bedrock, the VAB was well anchored, and fifty thousand cubic yards of concrete were used for pile caps and the ground floor slab covering the 7.5 acre foundation.

Into the building's skeletal frame were 45,000 separate pieces of structural steel weighing anywhere from 150 to 72,000 pounds each. Basically, the space-truss system of the framework was laid out in multiples of 38 feet horizontally and vertically. The building was designed for five wind conditions, including wind pressures up to 90 pounds per square foot and suction up to 105 pounds per square foot as well as dead, live and crane loads. The door mechanism was designed for a maximum operating wind of 63 mph, including gusts. Today, when winds are predicted, work platforms are withdrawn from any launch vehicle in the High Bay and the doors are closed. Erection of the steel framework began in January 1964, and the Corps of Engineers had the building topped out at 525 feet in April 1965. Some of the base columns have rolled section cores heavier than any previously rolled and weighing up to 734 pounds per foot. With





Measured in acres, High Bay doors to VAB are shown here during installation phase. Doors retract vertically, stack at the top during fully-open retraction.

plates welded to the cores, the columns are roughly two-feet square and weigh about 1,305 pounds per foot.

Once the frame was topped out and finished, the VAB was given an exterior skin (excluding doors) of insulated aluminum siding in a total area of 23 acres, plus 70,000 square feet of light-emitting plastic panels. The siding was designed not only to stabilize thermal effects but also to reduce accoustical pressures created by launches of the Saturn V vehicles. The panels of translucent plastic had the purpose of providing workers inside the VAB with a point of reference to the outside world without admitting glare or the direct rays of sunlight.

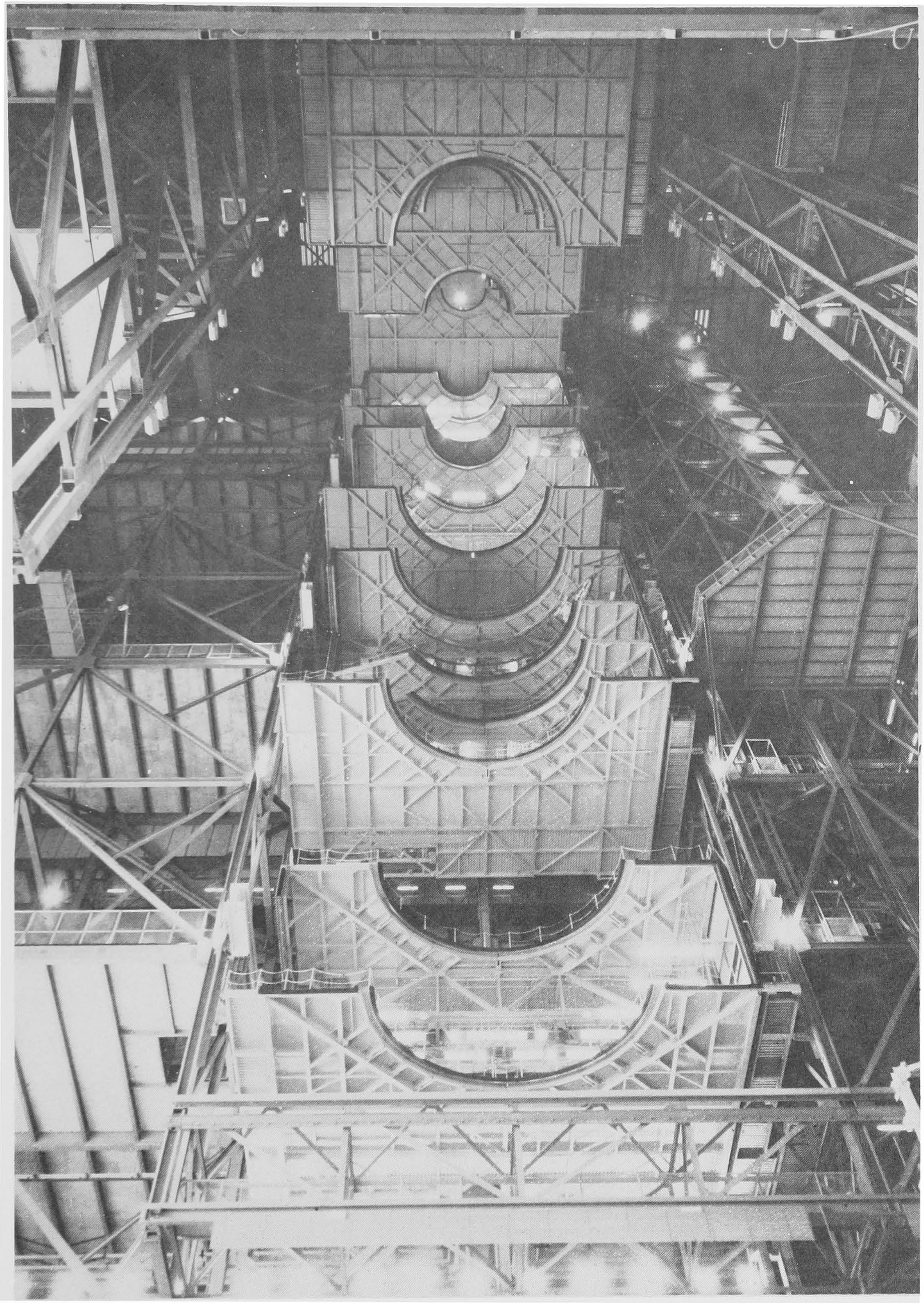
Developed interior floor area totalled 1.5 million square feet. Floors above ground level are lightweight reinforced concrete slabs four inches thick. The building's high bay has 26 fully developed floors; the low bay comprises three floor levels and a mezzanine.

The high bay doors on the VAB are in the shape of an inverted T, the lower portion of which is 152 feet wide and 114 feet high, and is closed with four leaves of doors (each weighing 73 tons) that slide horizontally, similar to the design used on many aircraft hangars. From the 114-foot level to 456 feet up, the doors consist of seven leaves 76 feet wide and 50 feet high, each weighing 32 tons; these leaves retract vertically and are stacked at the top of the structure when the door is fully open.

Each of the complex assembly areas in the VAB's high bay contains five pairs of extensible work platforms which permit ready access for technicians whose individual efforts manage the overall assembly and cohesion of the giant Saturn V moonrockets. The platforms, each a 60' by 60' square and measuring from one to three stories in height, were first assembled outside the VAB, then moved inside the building for erecting and mounting. All are completely air-conditioned and are vertically and horizontally adjustable to encircle the launch vehicle at random elevations and work levels. As these work-action platforms surround the vehicle, they are like giant arms coming together, with the Saturn V embraced in the circle they contrive. All are cantilevered about thirty feet from the main frame of the building.

Seventeen elevators run from ground level to 420 feet up, serving the extensible work platforms as well as fixed floor levels. An eighteenth elevator runs from the 420-foot level to the roof, and space has been allowed for future installation of four additional elevators should requirements dictate their later emplacement.

More than 70 cranes crisscross and span the vast interior to lift, move, adjust and deposit vehicle components. Outstanding are the two 250-ton bridge cranes and one of 175-ton capacity. Each 250-ton crane serves two vehicle assembly areas in the high bay. They weigh 500 tons apiece and have a bridge span of 150 feet, a hook height of 462 feet.



Looking aloft inside High Bay of VAB affords breathtaking view of extensible work platforms.

The 175-ton crane runs the length of the transfer aisle which interconnects both the Low and High Assembly Bays of the building. Hook height of this key transporter is 166 feet.

LAUNCH CONTROL CENTER

Although linked to the VAB by an enclosed above-ground channel (which is mainly a utility bridge), and having the appearance of a definite structural appendage to the VAB, the Launch Control Center relates to the Saturn V as a systems-monitoring and fire-control building -- once the missile is on the pad. The LCC performs interim monitoring during the assembly phase, but basically it is a Blockhouse miles-removed, and a sensitive on-scene comcenter in the immediate post-launch phase of the Apollo series. On the design and engineering side, the LCC has been regarded as part of the VAB entity.

The building is four stories tall, has four separate and distinct firing-control rooms which ostensibly give it two "reserve" fire command-centers beyond the present Saturn V needs at pads 39 A and B. Its design is unique, purposeful, as utilitarian to its function as a garage -- but somehow one can hardly envision a "garage sale" ever going on there.

Started in March 1964 and completed fourteen months later, the Launch Control Center -- although clearly a part of the overall VAB "body" -- won the 1965 Architectural Award for the Industrial Design of the Year. Overall, it is a four-story reinforced concrete structure, 378 feet long, 181 feet 6 inches wide and 77 feet 2 inches high. It is largely of precast and prestressed material, and outside walls at ground level are recessed to form an arcade around the building.

At ground level the walls are sheathed in precast architectural concrete panels surfaced in dark granite chips. The remainder of the building is surfaced predominantly in exposed cast-in-place architectural concrete. The north, east, and west exterior walls of the second floor are of un-insulated aluminum V-beam siding to match that on the VAB. The fourth floor south exterior wall is of insulated aluminum V-beam siding and large aluminum air-intake louvers for the mechanical equipment room. Doors and openings in exterior walls are aluminum with hurricane resistant laminated glass windows in aluminum framing.

Four firing rooms, each 80 by 140 feet and two stories high, are located on the third floor. Each firing room is designed to house 470 monitors and consoles for controlling the assembly and checkout of a launch vehicle in one of the four assembly areas of the VAB. The firing rooms are also used for controlling the

Launch Control Center (left foreground) showing window louvers. Vehicle Assembly Building in background.

Interior of Firing Room 1, Launch Control Center, indicates complexity of console operation. Note console-mounted and wall-mounted television monitors.

launches from the two launch pads.

Each of the launch control rooms has closed circuit television for "eyeball" supervision of launch operations, plus four rearview projection screens located on the fourth floor level, and visible to the firing room, to provide data displays.

To give launch crews a view of the pads, tinted 3/4-inch thick laminated glass windows are installed in each firing room. The windows measure 80 feet long by 22 feet high in each bay and reduce sound transmission into the firing rooms to normal audible levels during launch. They also allow only 28 percent of the outside light to penetrate, filtering those rays which cause glare and heat.

Condensation is controlled by thermostatic elements embedded in the window glass. Infrared lamps heat the exterior surface of the glass and prevent fogging by maintaining glass temperature above the dew point of the air outside.

The Launch Control Center at KSC, with four ready nerve-centers that could launch four Saturn V vehicles within brief time intervals of one another, came at a cost of $10,000,000.

COMMUNICATIONS AND ELECTRONICS

Probably at no point in its past history had the Corps of Engineers met the construction challenges in communications and electronics that were inherent in building space-age earth bases. The supervision of design and installation of vast and complex electronic and communications networks, validating their operational viability, coordinating their in-step on-time emplacement with all other phases of design, engineering and construction -- particularly in the spheres of Saturn V and support areas -- posed major new problems in management and organization.

These were finally resolved in January 1965 with the establishment of Com-Electronics Sections in both the Construction and Engineering Divisions, and the appointment of Communications and Electronics Project Managers with broad authority in the design and implementation activities on programs assigned to the District. In addition, separate Communications and Electronics Offices were established in the categories of Cable and Operational Systems. At each management level within the District, Com-Electronic Project Officers were placed organizationally within the command sphere in order to effect immediate solution to problems in concert with engineering and construction elements.

Overall, the Canaveral District supervised the design and installation of about $40 million in Com-Electronics work, a figure

which emphasized that these functions are no mere adjuncts or delicacies to the space-age menu, but represent execution, direction, correction, power-nourishment and the smooth and timely flow of myriad bits of vital information on which command decision must rest in missile-space activity. Indeed, space would still be the manless void of 1940 without the miraculous contributions of technology in the communications and electronics areas.

If steel and concrete form the skelton and muscle of Launch Complex 39, the communications and electronics systems must certainly be the eyes, ears and nerves. These systems allow the people responsible for conducting checkout, countdown and launch operations to control all activities, from the Command Module of the spacecraft throughout the pad, to the Launch Control Center, and, in fact, everywhere in the complex.

Criss-crossing and running the length and breadth of the complex is every current variety of telephone cable, instrumentation cable, coaxial cable, waveguide, and video cable - all in a single communications network.

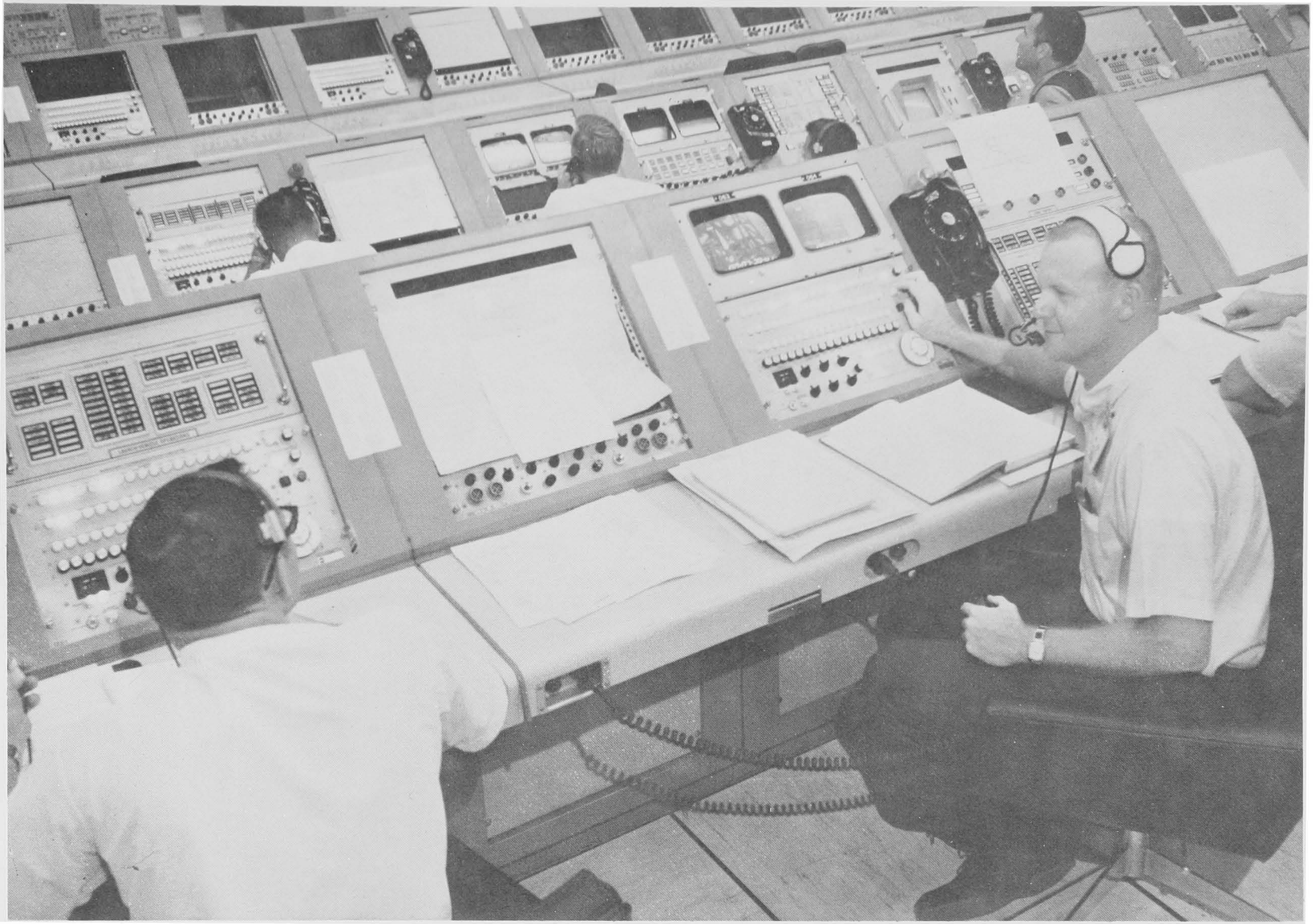
Among its many uses, this network is used by launch direction personnel in two crucial communication and control systems. One of these is the Operational Intercom System, which in effect is a large closed-circuit radio network. The other is the Operational Television System, which is also a closed circuit system using cable communications rather than radio waves.

The contract for production and installation of the Operational Intercom System was awarded in July 1965 and the installation was substantially completed in May 1967. The work on the Operational Television System was performed between September 1965 and January 1968. Both systems are adaptable to expansion.

The Operational Intercom System consists of some 2,000 dual-operator stations throughout the launch complex. These stations are organized into local communications areas, each of which has between 50 and 200 stations.

Each pad, each Mobile Launcher, each operational firing room of the Launch Control Center and the operational High Bays of the Vehicle Assembly Building compose these local communications areas.

These local communications nets may be organized into from one to four simultaneous missions so that all stations in the various local communications areas forming a mission may communicate. Each station has a capability of operating on two of 112 channels and thus communicating with all other stations on a given channel in the same local communications area during the same mission.



Dual eight-inch TV monitors are prime visual aid to launch controllers in Firing Room 1 of the LCC. All critical hardware elements of Saturn V, plus full spectrum of engineer performance, are communicated real-time to LCC to fully authenticate last-second launch commitment decision.

Any station can change channels at will.

The Operational Television System provides remote viewing of launch operations from the Mobile Launcher, the launch pad and the Mobile Service Structure as well as from other selected sites throughout the launch complex.

Pictures are distributed through a switching and distribution center which provides picture identification, camera viewing remote control, picture selection and countdown clock information to the Launch Control Center firing rooms at the direction of controllers in the firing rooms.

During launch operations, 50-plus cameras in the pad area supply pictures to a minimum of 80 monitor screens in the firing room in use.

When completed, the Operational Television System boasted 114 cameras and 255 monitors installed throughout the launch complex, complete with highly exotic switching, signal transmission, distribution and synchronization systems.

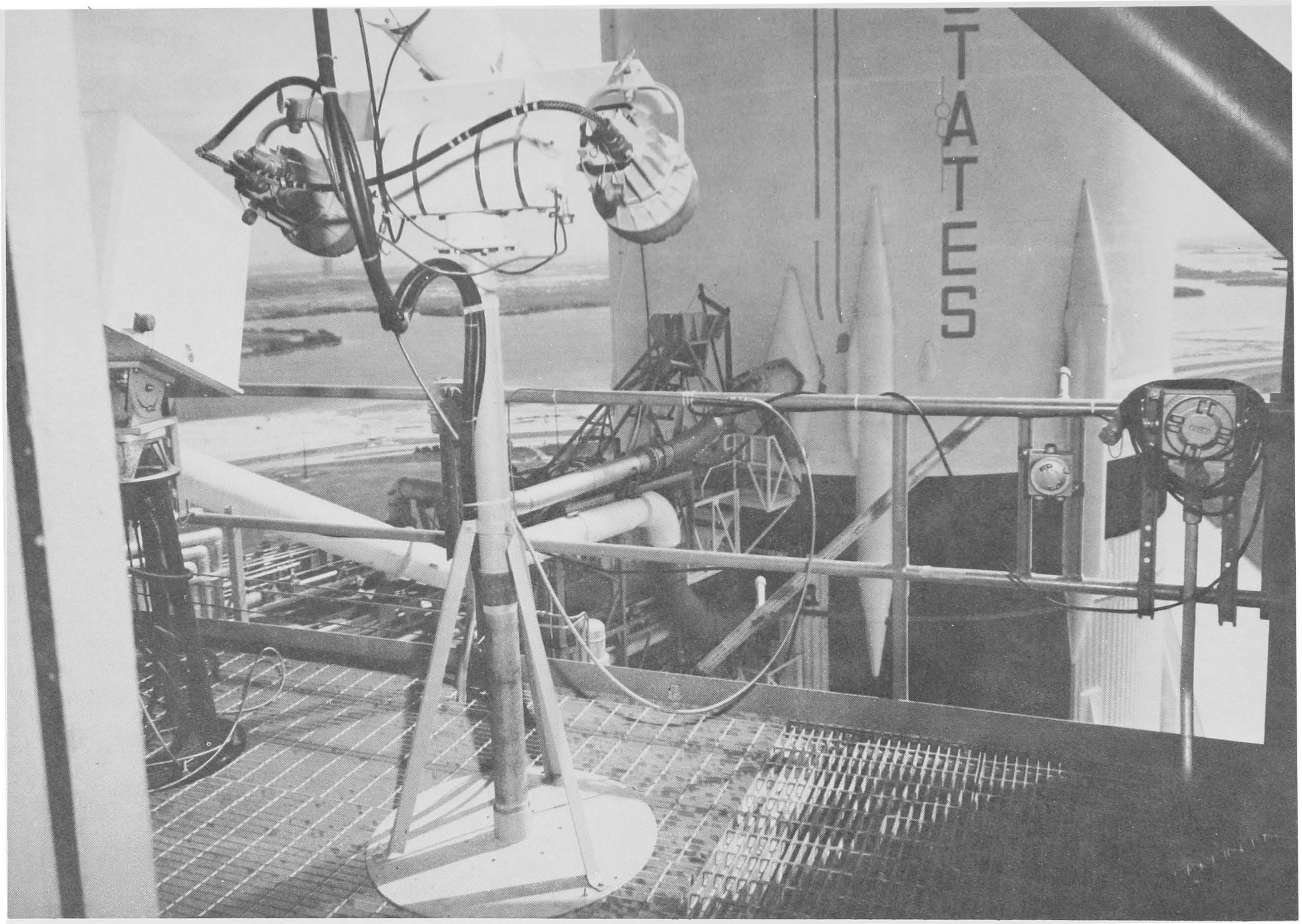
Capability of further expansion to accommodate operations in all four firing rooms of the Launch Control Center, all four High Bays of the Vehicle Assembly Building and a third launch pad have been designed into both the television and intercom systems. Their capability also includes features which allow their integration into communications systems at other NASA control centers, such as the Manned Spacecraft Center in Houston.

Besides the Operational Television and Operational Intercom systems, other communications and electronics work involved ultra high frequency radio links and walkie-talkies for communication with the Crawler-Transporter and Mobile Launcher during movement; video equipment for transmission of launch data to a dozen locations at Kennedy Space Center and Cape Kennedy Air Force Station, and color television equipment to feed the action of Apollo launches to the national TV networks.

CRAWLERWAY

Let's say you get the assignment of hauling a load of 17 million pounds, all in one married piece, from Point A to Point B. When you get the job, you're in the process of building Point A as well as Point B, and 17 million pounds already means a lot to you, if only from a parking standpoint. But 17 million pounds moving has an even greater bearing on your assignment.

We enter here a sequence in our Canaveral District, Corps of Engineers history, where the Corps was first involved as a coordinating



One for the Shutterbugs: This camera mount on Mobile Launcher is contrived to catch ignition and liftoff action at base of Saturn V when moonrocket leaves Complex 39. Elasticity is built into mount and all essential cabling to absorb launch-point shock moments.

This splendid view of Apollo 13 vehicle and Mobile Launcher en route from VAB to Complex 39 gives an idea of the scope and extent of Crawlerway construction.

road-builder, looking at the numbers and the tons and the thicknesses of things, the wind loads and static loads, the pressures per square inch (and for how long), the size of vehicle treads and the footprint of each. The Corps of Engineers had nothing to do with the design, construction or capacities of Apollo's Mobile Launchers and their giant Transporters, save for the sturdiness of where they parked, what they moved over, the bed they would behave on and, ultimately, the launch pad of their supercargo Saturn V.

Without the Mobile Launchers and Transporters being included here, we would lose the line of march, and since they are major components of the "action hardware" involved in our story, their seats have been taken.

Briefly, a Mobile Launcher (of which NASA built three for Complex 39) contains a two-story launch platform housing computers which are linked to the Launch Control Center. It is further composed of an umbilical tower which supports nine swing arms to give direct access to the launch vehicle. There are work platforms at 17 levels of the tower, plus distribution lines for propellant, pneumatic, electrical and instrumentation systems. The Mobile Launcher embraces the assembled Saturn V within the VAB and both are moved by a giant Transporter with a top-bed the size of a baseball infield. Two Transporters were designed and built under NASA supervision at a cost of $13.5 million. The transporter itself weighs 6 million pounds and can carry a load of 12 million pounds at a speed of 1 mph. Within each transporter, two 2750-horsepower diesels drive four 1000-kilowatt generators which in turn provide electrical power to 16 traction motors. Through a novel gear system, these 16 motors turn the four double-tracked crawlers spaced 90 feet apart at the corners of the Transporter. Each of the eight treads is 7.5 feet wide and 41 feet long, and each pad in the tread weighs about one ton.

Obviously, the strength characteristics of a crawlerway to accommodate this monster are enormous. To support the total 17 million pounds of a Transporter plus Mobile Launcher plus Apollo Saturn V, the Crawlerway averages 7 feet in thickness in two 40-foot wide lanes separated by a 50-foot median. The initial section -- 18,159 feet between the VAB and Launch Pad A -- was started in November 1963 and was included in the same contract under which Pad 39-A was built, with the exception of that portion in the immediate VAB area which came under the general construction contract of the VAB itself. This initial VAB-to-pad A crawlerway was completed in August 1965. At about 12,000 feet from the VAB, an additional section was undertaken in December 1964, running as a prime branch to Pad B. This section, of 11,300 feet in length and built under the Pad B construction contract, was finished in February 1966.

Each of the four dual tractor units of the Transporter was calculated to exert a 4.4 million pound load on the Crawlerway under

postulated "normal operating conditions", but potential imbalances due to windloads on the Transporter and its vertically-stacked cargo introduced considerations that could increase the load per dual-tractor unit to 5.4 million pounds. The Crawlerway was therefore built to withstand loads in excess of 12,000 pounds per square foot.

The variety of terrain to be traversed by this spaceage roadbed included dry land, swamp, sloughs, dunes, and bogs. Dry land borings showed acceptable subsurface material consisting mainly of fine sands down to -40 and -45 feet below sea level. In watery areas, soft silty sands and some soft clays were encountered above the fine sands observed in dry land portions. From an elevation of about -40 feet to bedrock at -160 feet, the material was more or less compressible, consisting of interbedded clays, silts and silty or clay-type sands.

The construction approach for the Crawlerway was basically similar to that for a highway-type causeway. After the softer unsuitable materials were excavated, more than 3 million cubic yards of hydraulic sandfill were placed on the route. This fill, under the trackways, was compacted with vibratory rollers and then proof-rolled with a 100-ton roller.

The roadway consists of three feet of graded crushed aggregate base course and 3½ feet of selected sub-base material. For the top surface on which the Transporter operates, river gravel was placed to a depth of eight inches on curves and four inches on straightaway sections. Elevation of the finished Crawlerway is 7½ feet above sea level except for the 5 percent grade on approaches to each launch pad. A 24-foot wide service road borders the Crawlerway on the south side in its approach to Pad A and on the east side of that section running to Pad B.

Paralleling the Crawlerway on either side are utility and pipe lines which link the control and assembly areas of Complex 39 with the actual firing areas. Communication and instrumentation lines were placed in ductbanks buried along the north side of the Crawlerway, with as many as 40 ducts per bank. At various points these lines pass through repeater buildings.

High pressure gas lines also flank the Crawlerway on its north side and are supported above ground on precast concrete posts and piers. Power duct lines and potable water piping run south of the roadbed. At points where lines or piping systems cross or pass beneath the Crawlerway, access tunnels were constructed to withstand the load conditions of the roadway itself.

MOBILE SERVICE STRUCTURE

Once the Saturn V and its Mobile Launcher are placed on-pad, the Crawlerway is again used to bring the Mobile Service Structure into position. This 402 foot servicing tower (MSS) is used to provide personnel-access to Saturn as it stands in launch position.

The MSS is required to implement the final inspection of the launch vehicle and to load hypergolic and cryogenic propellants in the spacecraft. By positioning the structure next to the Saturn V on the pad it is possible to maintain the air-conditioned environment required for final servicing of the Apollo spacecraft.

Construction of the MSS by the Corps was done at its "park" position along the south side of the Crawlerway, approximately one mile from Launch Pad A. The MSS is moved to and from the pad by the Transporter.

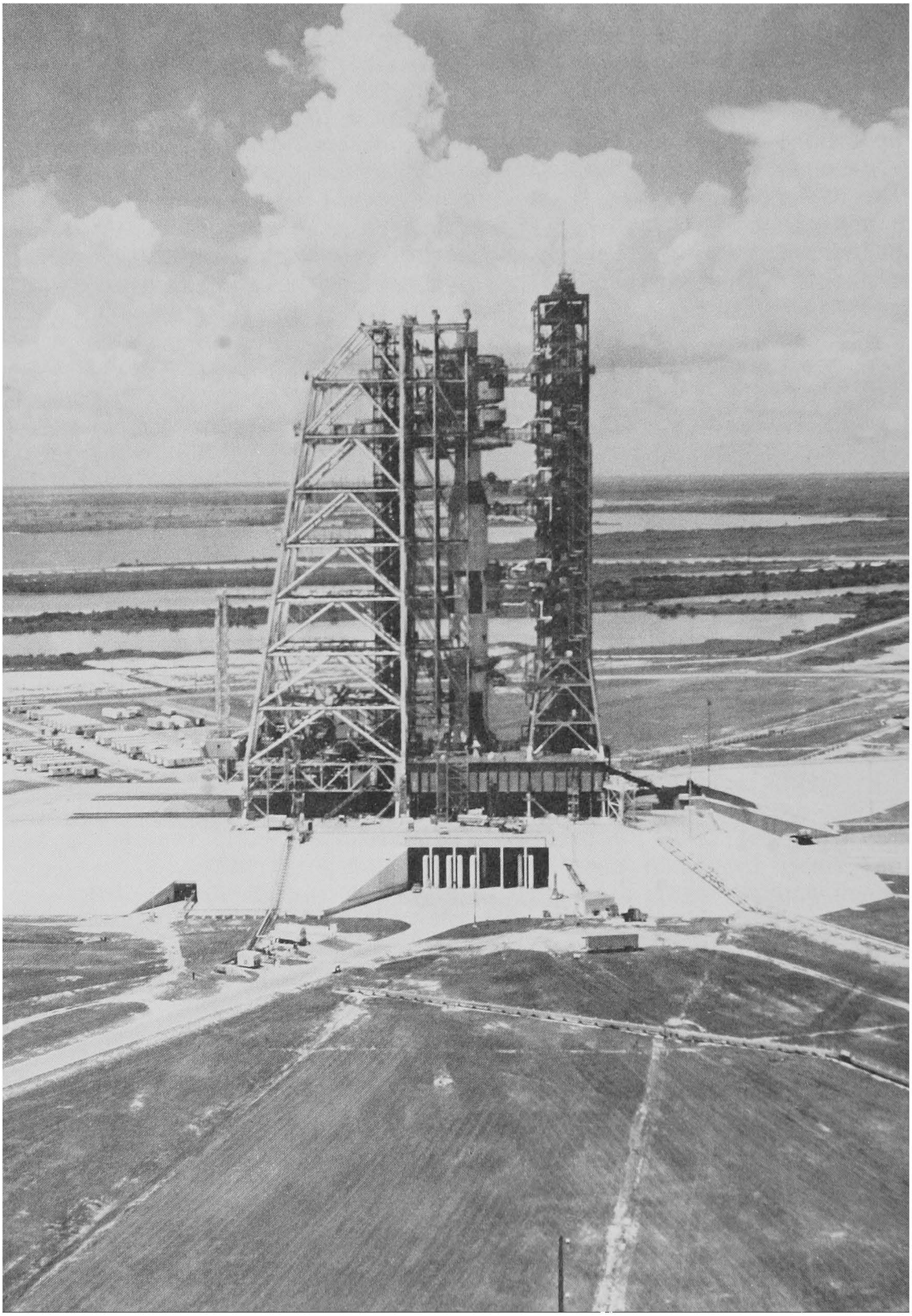
At its base, the MSS is 135 by 132 feet; at its top 113 feet square. It weighs approximately 9,800,000 pounds.

Fabrication of the steel for the MSS started in October 1964. Construction in the field began in February 1965. The structure was topped out on November 19, 1965 and the work was substantially completed in July 1966. The tower was moved atop Pad A for the first time on July 22, 1966 and successfully mated with a Mobile Launcher and a facilities test model of the Apollo-Saturn V.

The general structural configuration of the MSS consists of a set of base trusses approximately 22 feet deep by 130 feet square and a series of eight tower sections, each approximately 44 feet high. In final form, the tower consists of four upright trusses, side-by-side, each approximately 335 feet high, resting on a 22-foot-deep base truss complex 130 feet square. The addition of bracing members across the front and rear planes of the tower form two additional lateral trusses. Altogether the tower and base structure consists of 1,458 pieces of steel, weighing 7,690,933 pounds, connected at 416 joints.

To reduce wind loading and save weight, structural steel tubing was used for most of the tower's framework. The tower was put together in pre-assembled sections. These sections were welded at the fabrication plants, bolted while on the ground and hoisted to position by cranes and derricks.

To minimize weight, flooring on the tower is of aluminum honeycomb panels. This material not only reduced weight but its structural rigidity assured stability of the floors.



First flight version of Apollo-Saturn V launch vehicle is checked out at Pad A of NASA's Kennedy Space Center prior to launch on November 9, 1967. Tower to right of vehicle is Mobile Launcher; structure to left is Mobile Service Structure.

Feature of Mobile Service Structure construction was safety net to halt the fall of steel sections or personnel during construction. It was built in the "park" position south of Crawlerway and about a mile from Pad 39-A.

Since the basic functional requirement of the MSS is to provide personnel access to the Apollo-Saturn V, five work platforms are cantilevered from the forward plane of the tower. These platforms are opened as the tower approaches the pad and then are closed around the launch vehicle and spacecraft after the MSS is in place.

The three upper platforms are in "fixed" positions although they can be repositioned at various levels to serve vehicle configurations which may be developed in the future. In their present positions the upper platforms service the Launch Escape System and the Apollo spacecraft's Lunar, Service and Command Modules.

The two lower platforms service the Saturn V launch vehicle and are vertically self-propelled by the technicians working on them so that the workers have access to the entire surface of the vehicle.

The five platforms are mounted on gear-tooth racks which run the full height of the platform support structure. The two self-propelled platforms are powered by electric motors driving gears which move the platforms up or down the tower at 10 feet per minute. The fixed platforms are locked onto the racks but can be repositioned readily with a system of cables and sheaves using one of the self-propelled platforms as motive power.

Two high-rise elevators are provided in the tower structure to carry personnel and equipment to the various working platforms. The elevators have a capacity of 5,000 pounds of equipment or 12 to 16 people.

A separate elevator with the same capacity provides access to the basic working level of the tower, which is 47 feet above ground. This elevator can be raised onto the structure for clearance when the Transporter is moved under the tower. From the basic working deck, personnel can walk to the high-rise elevators. A manlift elevator is also used to provide access from the ground to the base work area.

Ground-mounted hold-down clamps restrain the tower from overturning in high winds. One of these clamps is located at each corner of the tower.

Additionally, at the four corners of the tower, shear blocks are provided which fit into cavities in the tops of the support columns.

The MSS can withstand winds of 85 miles per hour in the pad position with holddown clamps; 125 miles per hour in the park position with holddown clamps, and 63 miles per hour when standing free.

A variety of buildings are provided on the base working level of the MSS for electrical, mechanical, elevator, communications and television equipment, operations support and toilet facilities.

Total cost of this facility was in excess of $19,000,000.

LAUNCH PADS 39A AND 39B

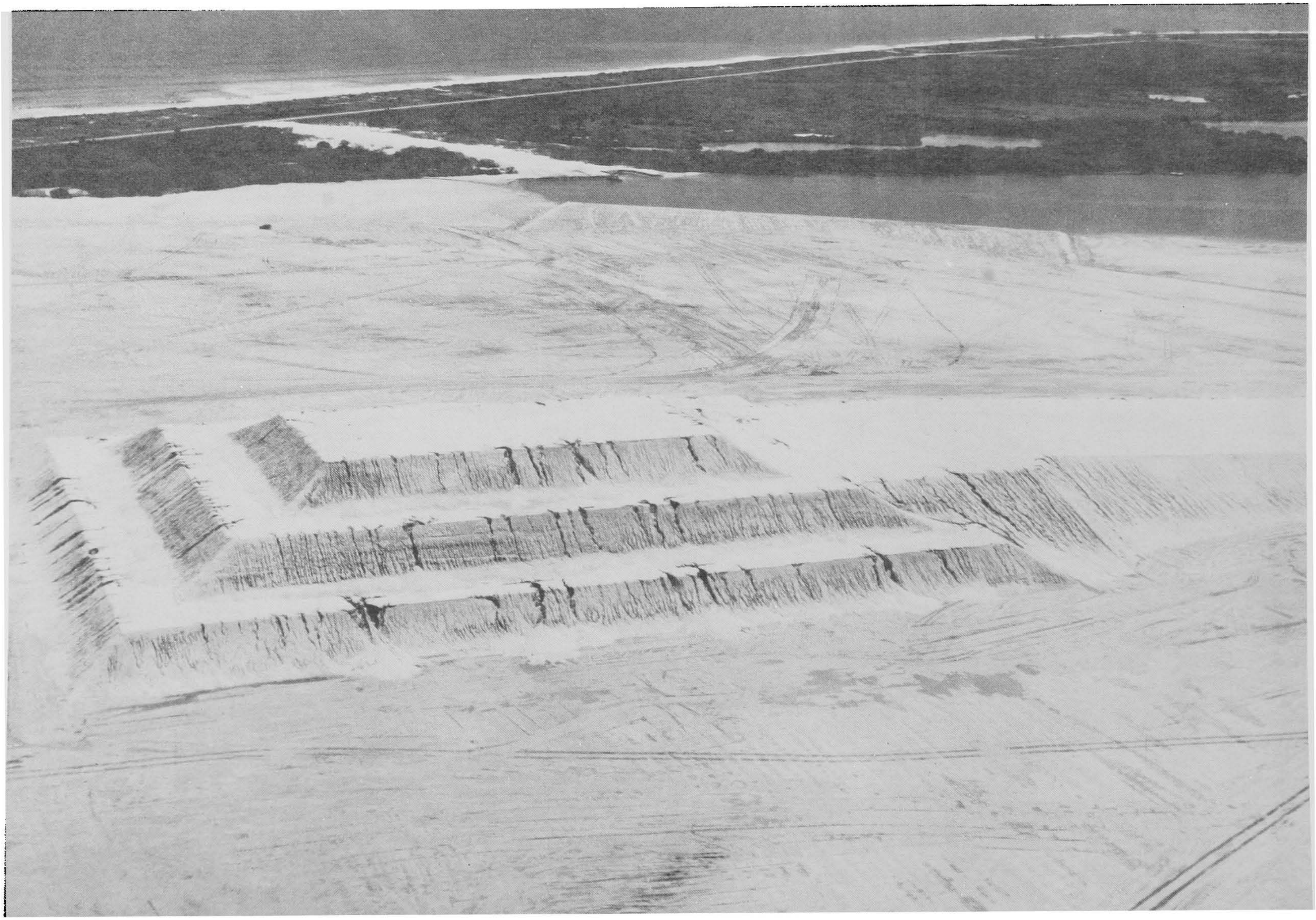
Tucked close by the Atlantic at NASA's John F. Kennedy Space Center, the two massive launch areas for Apollo's Saturn V series have already cast challenging shadows along mankind's future and awakened him to the new frontiers that await his hand. This storied spot -- the subject of millions of words of news copy and other material -- has been looked upon by all the world via television, has been described in many tongues by all manner of media and by every writing type from the space-age reporter to the novelist, the philospher, the poet.

For this history it appears appropriate to set our descriptions down from the engineer's point of view, as from the engineering archivist, if you will. This will tend to hold us hard by factual description, and perhaps rob us partially of color, but if the prose comes flatter than some, we know that the subject stands tall on its own eloquence.

Launch Pads A and B for Complex 39 are virtually identical. Each pad area covers approximately one-quarter square mile and the pads are 8,716 feet apart. Both pads are connected by the Crawlerway with the Vehicle Assembly Building. Launch Pad A, measured by the Crawlerway, is 18,159 feet from the VAB; Launch Pad B, 22,400 feet. The flame trench of each pad faces due north.

Each launch pad area consists of several major components. The launch pad proper includes the hardstand; the Pad Terminal Connection Room (PTCR), the Environmental Control System (ECS) Room, the High Pressure Gas Storage Facility, the flame trench and apron, and the Emergency Egress System. Perimeter structures in the pad area include the Liquid Oxygen, Liquid Hydrogen and RP-1 fuel storage facilities, holding ponds, camera pads and the flame deflector park position.

The two pads were built under separate contracts. Construction of Pad A started in November 1963 and the work was substantially completed in October 1965. A facilities test model of an Apollo-Saturn V was moved atop Pad A on May 26, 1966. Construction of Pad B began in December 1964 and the work was substantially completed in April 1967.



Reminiscent of an ancient pyramid, this accumulation of 500,000 cubic yards of surcharge fill occupies the site of 39-A. Dredged from Banana River, the surcharge pile placed a 1.5 billion pound load on the construction site. When the pyramid had settled the pad area about 4 feet, the surcharge was removed and construction began.

Because of the generally swampy conditions existing in the area of Pads A and B, the construction sites for both were surcharged prior to construction to consolidate the lower soil stratas. An 80-foot high pyramid of dredged fill from the Banana River and surrounding area was placed on each site. These pyramids settled the pad area approximately four feet before they were removed and construction began. Each of the surcharges required more than 500,000 cubic yards of fill and weighed in excess of 1,500,000,000 pounds. During their existence, the pyramids were termed the "highest mountains in Brevard County" -- an accurate statement.

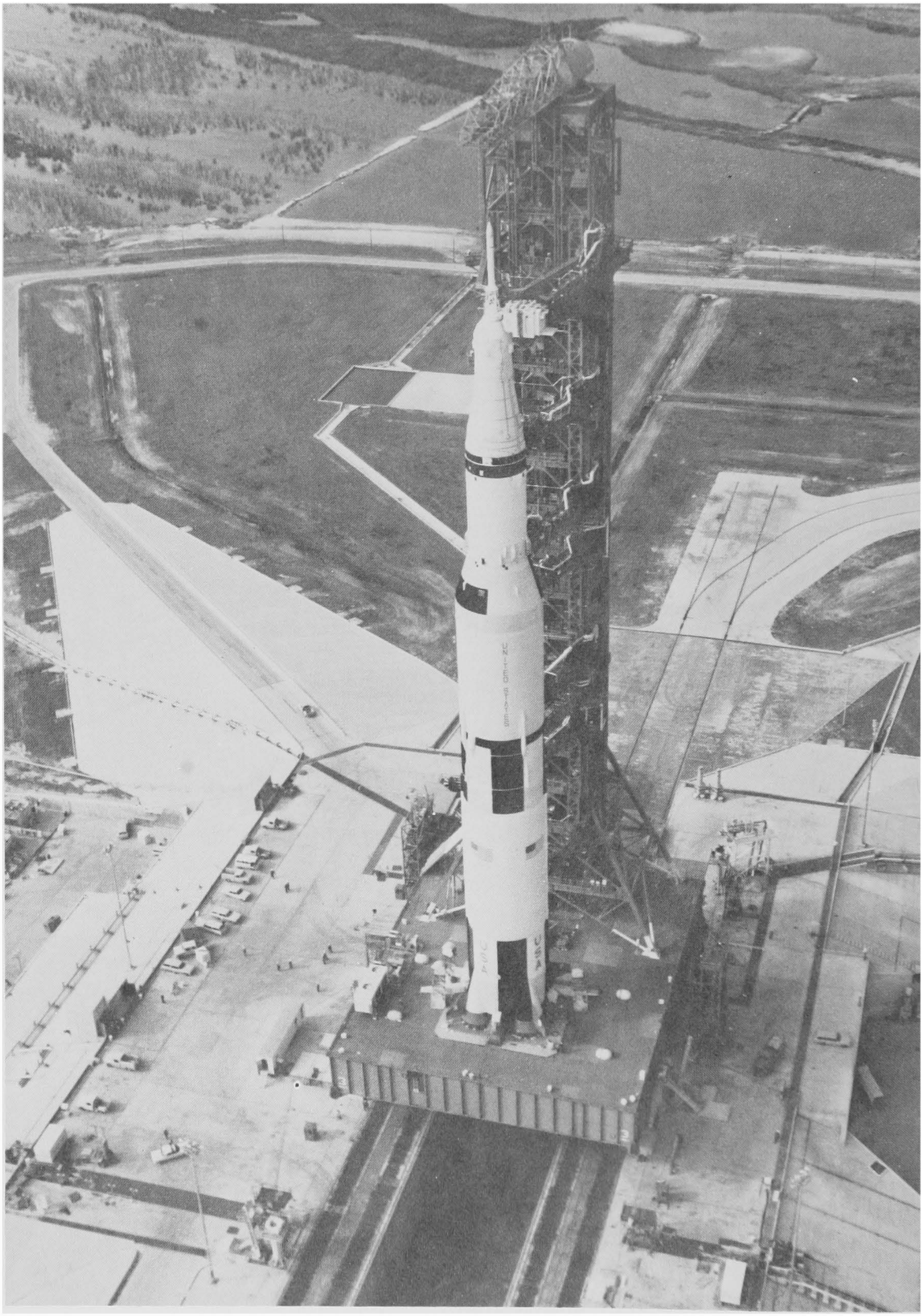
Since the top of each pad is 42 feet above the bottom of the flame trench, two cellular structures were developed paralleling the flame trench to support the various loads of the Transporter with the Mobile Launcher, launch vehicle, and the Mobile Service Structure.

The parallel cellular structures, approximately 400 feet long, 40 feet wide and 42 feet high, are made up of individual cells with concrete diaphragms at 20-foot centers. The longitudinal walls of the cells are approximately three-feet thick and the diaphragms are 33 inches thick. Beneath the cellular structure and the flame trench is a concrete mat, 11 feet thick, 150 feet wide and 450 feet long.

One of the major engineering problems was the design of the roof slab over the cells to support the Transporter and its loads. The bearing pressures exerted by the tracks of the Transporter are in the range of 10,000 pounds per square foot. A surface 30 feet wide and 520 feet long on each side of the flame trench was designed to be supported by the cell roof slabs. This surface is of 15-inch deep welded grating. The grating is bolted to imbedded anchor strips and filled with small aggregate concrete. The grating is covered with a resilient operating surface for the Transporter.

Located on the hardstand are service towers which provide interface connections between the pad facilities and the Mobile Launcher for liquid oxygen, hydrogen, RP-1, electrical power and communications, compressed air and environmental control systems.

Also located on the hardstand are the support pedestals for the Mobile Launcher and Mobile Service Structure. The pedestals are designed to support the structures at wind velocities of 80 miles per hour. Some of the service structure reactions on the support pedestals are as high as 8,000,000 pounds. During the firing phase of the vehicle, the Mobile Launcher is supported by six permanent legs and four additional extendable arms that are temporarily fastened to the bottom of the launcher platform and the pad to take the dynamic loads and the rebound that is computed



This view of Pad 39-B shows Apollo 10 in launch configuration. Note the antlike size of men below and to the left of vehicle.

between 7,000,000 and 10,500,000 pounds at liftoff.

The slope from the elevated top of each pad to the general grade level 40 feet below is retained by four-inch thick concrete paving.

Altogether, each pad contains 68,000 cubic yards of concrete and 5,100 tons of reinforcing steel.

The flame trench, located in the center of each pad, is 450 feet long excluding the apron at its north end. The trench is 58 feet wide and 42 feet deep.

During launch, the floor and walls of the trench are protected with a refractory brick surface that can withstand temperatures up to 3,000 degrees Fahrenheit, positive and negative pressures of 2-to-10 pounds per square inch and flame velocities in the range of Mach 4. The refractory brick surface has a smoothness tolerance of one-eighth inch in 10 feet.

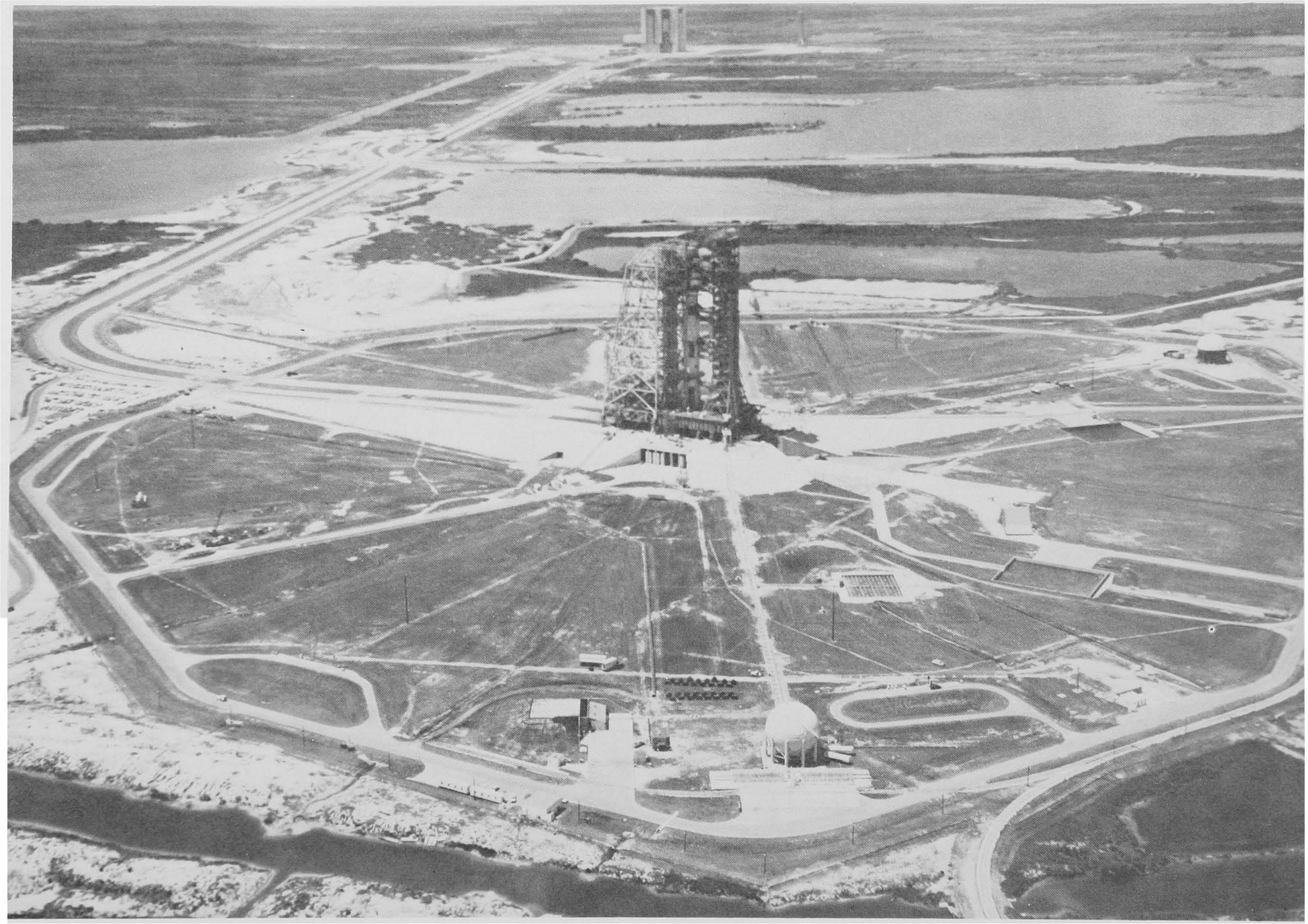
A rail system for the flame deflector is provided in the floor of the trench along with anchorages capable of withstanding the thrust of the vehicle during launch. A park position is provided in the splayed area north of the flame trench for the flame deflector when it is not in use.

The flame deflector at each pad is a steel, roof-trussed structure with a refractory concrete surface. The deflector is 41 feet 6 inches high, weighs 650 tons and is moved by an external prime mover. The deflector has steel wheels and is anchored into place with thrust locks.

The Pad Terminal Connection Room (PTCR) contains two stories and is located on the west side of the flame trench beneath the sloping shoulder of the pad. It is covered with as much as 20 feet of earth fill. It houses electronic equipment which provides a connecting link for communication and digital data link transmission lines from the Launch Control Center to the Mobile Launcher. The room is built of reinforced concrete.

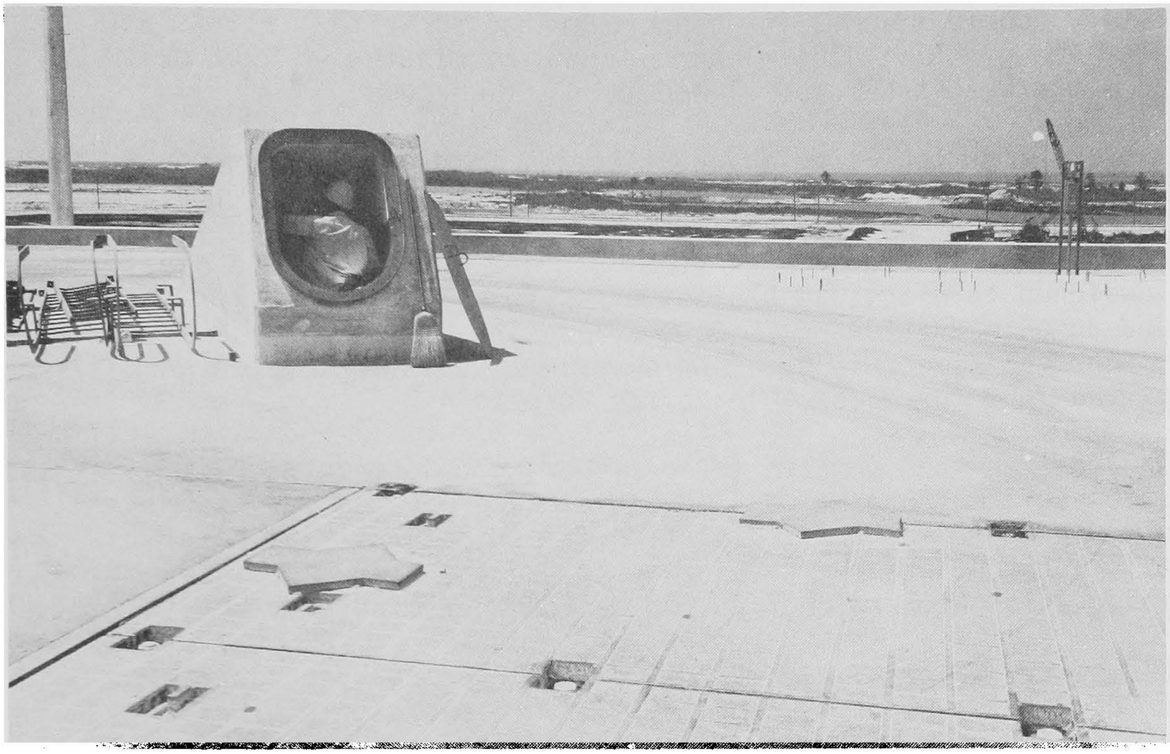
Also buried beneath the shoulder of the pad on the west side of the flame trench, the Environmental Control Systems (ECS) Room contains one story and is similar in construction to the PTCR. It serves as a distribution point for conditioning and purge gases.

The High Pressure Gas Storage Facility is located beneath the top of the pad on the east side of the flame trench. It is also built of reinforced concrete and is used to store nitrogen and helium used for pressurizing electrical and water systems.

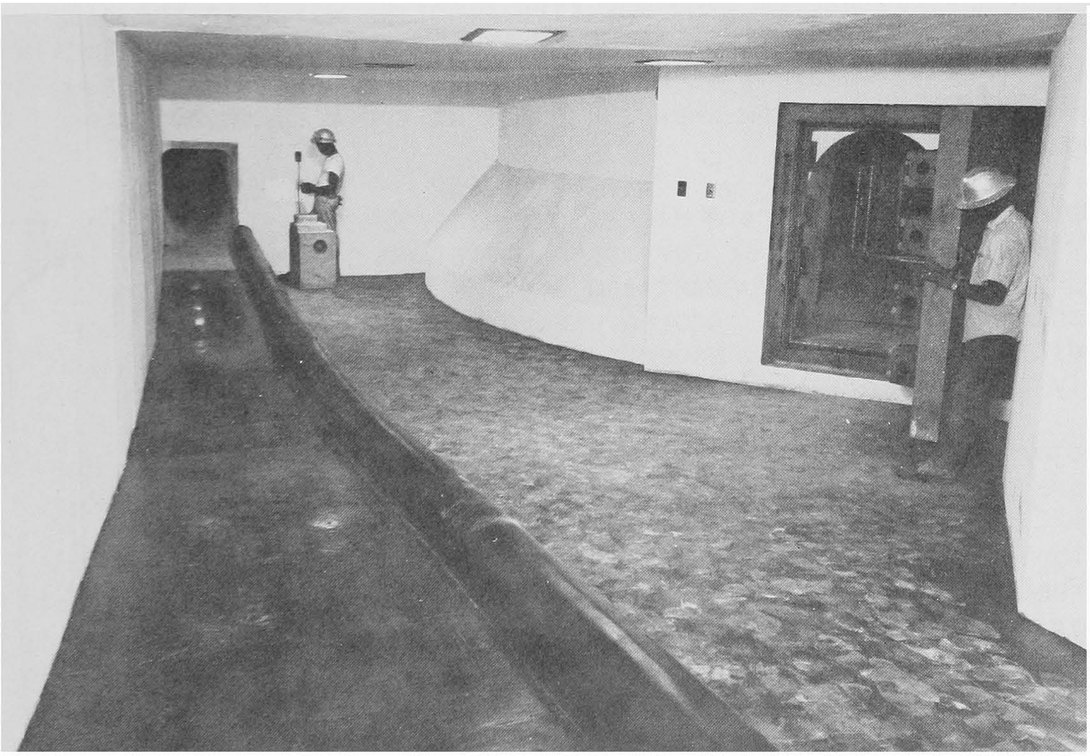


The westward view, Pad 39-A sits in foreground, with VAB in distant background and Crawlerway between. First flight model of Apollo-Saturn V sits on Pad, flanked by Mobile Service Structure (left) and Mobile Launcher.

Personnel escape system for use in a pre-launch emergency.



Entrance to egress chute at top of Pad 39-A.



Bottom of egress chute in termination room and door to blast resistant room.

Both pads contain a personnel escape system for use in a pre-launch emergency. The system contains a stainless steel chute, approximately 200 feet long, in a superelevated curve that starts at the interface with the Mobile Launcher and terminates 40 feet below the pad structure in a rubber-lined termination room.

A blast resistant room adjacent to the termination room contains 20 contour chairs and safety harnesses as well as survival equipment for a period of 24 hours. The blast room is dome-shaped, 40 feet in diameter, with 2-1/2-foot-thick steel and concrete walls and steel doors designed to withstand a blast pressure of 500 pounds per square inch and an acceleration of 75 Gs. A floating concrete floor supports the contour chairs and is built on a spring suspension system which reduces the 75 G force possible on the dome to 4 Gs.

In addition to a potable water system, provided through pump facilities in the VAB area, an industrial water system serves both launch pad areas. The pumping station for this industrial water system is located near the Crawlerway to Pad B and is capable of furnishing water at a rate of 45,000 gallons per minute.

Industrial water at each pad is distributed through separate industrial water subsystems for Mobile Launcher deck flushing; flame deflector quenching and cooling, umbilical arm cooling, engine chamber deluge, and pad surface and flame trench wall flushing. These subsystems are zone-controlled from the Launch Control Center.

The pad FIREX system provides fire fighting water to the pad propellant storage facilities, high pressure gaseous hydrogen facility, Mobile Service Structure, perimeter fire hydrants, and Mobile Launcher fire hose connections from separate pumps at the industrial water pumping station.

Both pads have separate electrical distribution systems, one for industrial power, the other for instrumentation purposes. The industrial power system is redundant and provides dual feeders to major load centers. The system incorporates emergency diesel generators for additional reliability under critical loads. Both systems are remotely controlled.

Major support facilities in the perimeter area of the pad are the storage facilities for liquid oxygen, liquid hydrogen and RP-1.

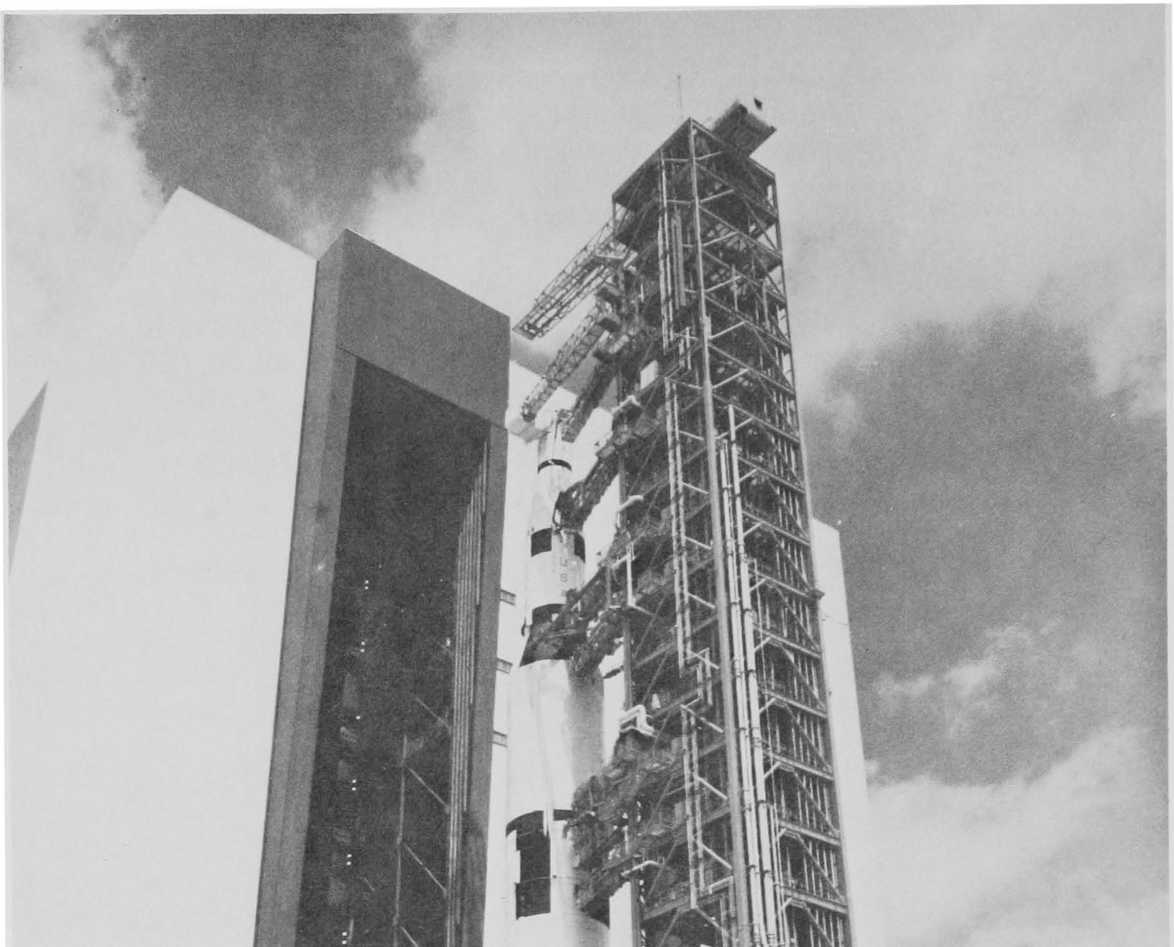
Liquid oxygen is stored in a 68-foot 9-inch sphere located 1,450 feet from the pad. The double-walled tank has a carbon steel exterior and is lined with stainless steel. Capacity of the tank is 900,000 gallons. Pumps transfer this oxidizer to the vehicle at a maximum rate of 10,000 gallons per minute through a 14-inch transfer line.

The S-1C stage fuel, RP-1, is stored in three 86,000-gallon tanks for a total capacity of 258,000 gallons. The tanks are located 1,350 feet from the center of the pad, on the east side of the pad. The RP-1 is pumped to the vehicle through an 8-inch line at a maximum rate of 2,000 gallons per minute.

An 850,000-gallon liquid hydrogen tank is located near the RP-1 tanks, 1,450 feet from the pad. The hydrogen is transferred to the vehicle through a 10-inch line at a maximum rate of 10,000 gallons per minute.

Propellant loading is remotely controlled from the launch Control Center.

Total cost of the two launch pads with support facilities approximated $52,000,000.



First Apollo-Saturn V spacecraft and rocket erected in the Vehicle Assembly Building leave on their maiden, 3½-mile trip to the launch pad.

CHAPTER V

INDUSTRIAL AREA (NASA)

To support NASA's vast moon launch complex with all the detailed scientific and technical backup and logistics required, the Canaveral District put together a unique and modern "city" at the Kennedy Space Center on Merritt Island costing more than $60 million.

Known as the Industrial Area, this "city" is in many ways typical of any other town its size from the standpoint of common facilities and functions: there is a postoffice, bank, power station, fire station, sewage plant, theatres, cafeterias, a railroad yard. Everything from barber shops to newsstands accommodate the workaday population which has run to 14,000 people in periods of peak activity. More than fifty buildings, many of them among the most architecturally attractive in Florida, make up this bustling space-town.

The city is -- from a business standpoint -- a thing all its own, a hub unlike any other anywhere, since almost every structure in some way helps accommodate the vast array of complicated, diverse and essential space-related activities. Buildings with strange and exotic names abound: a Hypergolic Test Building, another for testing Cryogenics; a Parachute and Paraglider Building, Manned Spacecraft Operations Center, Central Instrumentation Facility, and over three dozen others with equally special space-age names: Propellent Systems Components Lab, Launch Equipment Shop, Pad Water Pumping Station, and so on.

Located five miles south of the Apollo launch complex, and linked to it by a four-lane highway (Kennedy Parkway), the Industrial Area has arteries to the outside world via high overwater bridges, 38 miles of highspeed causeways and highways, and a 16-mile railroad network that serves interior purposes and is a feedline for inbound supply.

Buildings designed for Apollo Spacecraft checkout and launch preparations occupy a section of several square blocks in the eastern portion of the Industrial Area, near the Banana River. The largest of these, the $21.5 million Manned Spacecraft Operations building, contains 600,000 square feet of administrative, laboratory and spacecraft assembly areas. The assembly portion consists of a high bay 224 feet long and 100 feet in height, and a lower assembly bay 251 feet long.

Here are housed two identical heavy-steel altitude chambers, 55 feet tall and 34 feet in diameter, or big enough to receive and

This 1966 photograph of NASA Industrial Area shows the complex nearing completion but already operational. Located five miles south of moon launch pads, Industrial Area serves all support requirements of Apollo program.

check out the Apollo spacecraft in a simulated environment of 250,000 feet above the earth's surface. All three prime segments of the spacecraft -- the command module, service module and lunar module -- must be electrically mated within the chamber for these tests.

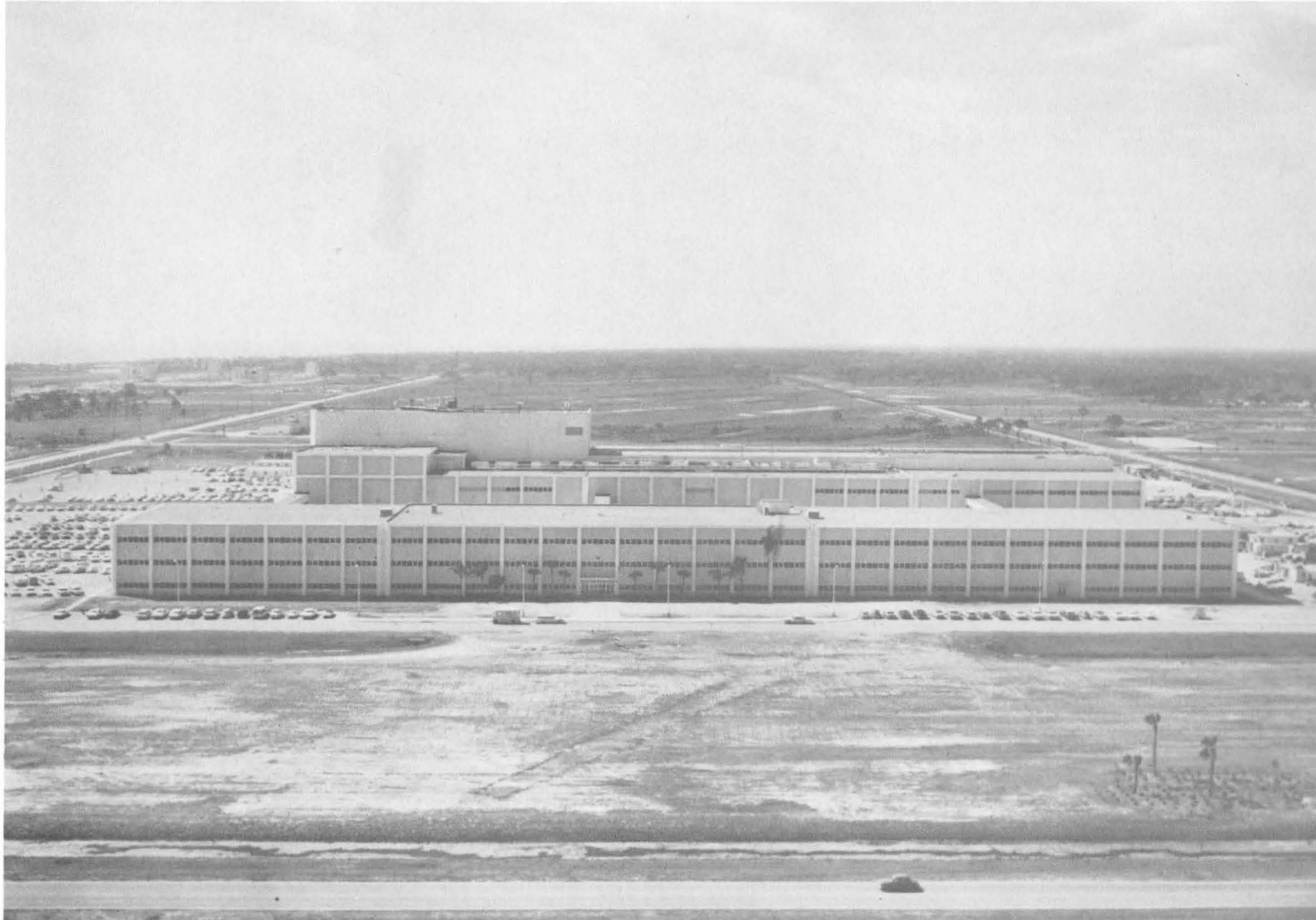
The Manned Spacecraft Operations building also contains bachelor quarters for lunar astronauts, gymnasia, medical clinics, training areas for flight systems orientation and mission studies, command and lunar module simulators, and all of the preparatory devices and gear required to ready a flight crew for its journey.

The building also contains laboratories for biomedical and flight experiments, for the investigation and check-out of guidance, navigation, electrical, communications and environmental control systems, and for the calibration and confirmation of all instrumentation and back-up systems within the entire launch and flight package.

(The criticality of parachute rigging has often been demonstrated to a breathless world on global television when spacecraft return to earth for ocean splashdowns, descending on the braking support of three giant 'chutes. These are carefully rigged and packed on a 180-foot table after rigid inspection. Astronauts personal parachutes are also packed in a long low concrete structure near the Manned Spacecraft Operations building.)

Much on the order of the Technical Laboratory at Patrick AFB, NASA's Central Instrumentation Facility in the Industrial Area costing about $7.1 million probes electronically every phase of the pre-flight preparation as well as the launch and post-launch performances of Saturn V rockets as they carry out the first critical step of manned flights into space and to the moon. Here -- in a finely controlled environment -- batteries of computers read-out and collate data acquired via telemetry, radar tracking, television and other electronic means; data is reduced, processed, passed along in real-time sequence to the Marshall Space Flight Center at Huntsville and the Manned Spacecraft Center in Houston. Measurements of skin and internal missile temperatures, engine thrusts and related performance parameters, wind and atmospheric pressures, fuel flow rates in the early-flight phase, all are distilled here for the trained and eager eyes of engineers and controllers.

Standout edifice of the space-age city is a handsome $8.3 million headquarters building for NASA's Launch Operations Center. Undertaken along with the rest of the Industrial Area complex in November 1963, the 3-story reinforced concrete structure contains 320,000 square feet of floor area housing administrative offices and planning and management facilities. Construction was done in two phases, with the building's central structure, covering 261 by 236 feet, going up first; east and west wings were added during the



Aerial oblique view of the Manned Spacecraft Operations Building in NASA Industrial Area.

Entrance to KSC Headquarters Building in heart of Industrial Area.

second phase, each measuring 217 feet frontage with depth of 160 feet. From award of contract to placement of the final sodding, the Headquarters was built in one year's time.

Save for the human brain, nothing is so critical to the function and vitality of the Industrial Area as the human voice and ear, and more than 10,000 telephones accommodate these two essentials. The telephone exchange handling this traffic is big enough to meet the needs of Titusville, Melbourne, Cocoa or any of the nearby cities and towns; and much of what this level of voice communication sets in motion is carried out by equally impressive transportation facilities. The General Services Administration made available to the Kennedy Space Center more than 1,250 vehicles, about 500 of which are passenger carriers and the remainder variously suited to the many types of cargo in daily haul. GSA maintains, services and fuels this fleet, which at times of peak load averages well over a million miles a month.

Other heady statistics abound in the official fact sheets and other public releases of the Corps and NASA, but a neat capsuled paragraph (pertinent here) is found in the Kennedy Space Center Story (NASA - 1967): "In four years, 4,379,692 tons of cement, sand, gravel and aggregates were delivered to the Center, plus 569,026 tons of steel and lumber, 22,000 tons of wire, cables, conduit and pipe, and 8,250 tons of components for the mobile launchers, crawlers and cranes installed in the Vehicle Assembly Building and other structures. Of these quantities, 3,840,000 tons arrived by truck, 1,127,750 tons by rail and 11,218 tons by barge."

But for all that -- and as a phantom footnote to history -- there was an "authoritative source" tale running rampant in Brevard County in the pre-construction days that a complete set of plans and specifications for NASA's Merritt Island launch complex weighed only 900 pounds.

CHAPTER VI

A NEST FOR TITAN III

The Banana River in Florida has nothing to do with bananas and it is not a river. Its shape is more like a kosher bologna than a banana, and it is in essence a large salt-water lagoon with a tiny outlet at its south end which runs into the Indian River. The northern portion of this long and shallow bay sits west of Cape Kennedy. In the fall of 1962 a giant dredge named Pittsburg moved into these limpid shallows, lowered its massive suction gear into the three-foot depth and brought up the first of 7-million cubic yards of fill that would compose a space-age island chain for assembly of the imposing new military booster, Titan III-C.

The initial Air Force projections for its new Integrate-Transfer-Launch facility for its TitanIII-C postulated frequent short-notice military space missions requiring boosters "at the ready" to fly into space for a broad spectrum of military purposes. It would have other capacities: to orbit space laboratories, place payloads of up to 25,000 pounds in low-earth orbits, fly high circular or eliptic orbits with payloads of up to 13,000 pounds, launch missions into deep space from low parking-orbit positions, change orbital planes in flight by means of a transtage multiple-start capability.

The concept called for a fully integrated, stored and ready booster, with a short reaction time.

Three years after the Pittsburg took its first mouthful from the Banana's bottom, the Corps of Engineers delivered to the Air Force its Integrate-Transfer-Launch (ITL) facilities.

Since the preparation of this Titan ITL package went forward almost in tandem step with NASA's moon-launch complex, the Corps' total contingent of 600-odd design, engineering and construction supervisory people -- and a labor work-force of more than 8,000 -- hit some impressive milestones for heavy construction contracts. A couple of pertinent quotations may illustrate:

A Corps Technical Liaison Officer : "In one 12-month period they completed $166.5 million worth of construction on the Titan III system, the NASA VAB and Apollo launch pads, the JFK Space Center Headquarters and Manned Spacecraft Operations Buildings in the KSC Industrial area, and dozens of other related facilities."

Most photogenic space package yet launched from Cape Kennedy could be Titan III-C. Here it scoots aloft in a pattern of westering sunlight which outlines where its pieces arrived, where they were assembled, and shows rail network that got it to the launch pad. This remarkable aerial photograph (helicopter) shows -- at bottom of picture, low right center -- the dockside reception site for rocket components. At lower centerstage is the imposing Vertical Integration Building where main core of Titan III is put together. Four tall doors of VIB mark the main bays where four missiles may be assembled simultaneously. Rail network on main island includes small marshalling yard in front of VIB, and rail line then runs eastward through center of Solid Motor Assembly Building (SMAB) where solid boosters are strapped to main core en-route to launch, which in this instance is from Pad 40. Pad 41 is barely visible here at mid-center left. Other low-level buildings on main island are for warehousing and rocket component storage.

Chief of the Construction Division: "Looking back, I still find it all a little unbelievable. Some days I'd drive out in the field in the morning to inspect the projects, and there would stand a million dollars worth of new construction that wasn't there the day before."

One January day in 1965, a contractor walked out of the Canaveral District offices on Merritt Island with a check in his hand -- for $9,532,753.12. This covered the work his company had accomplished in the previous four weeks. It would be easy to forgive him if he smiled. The month before, on payday, his check had only amounted to $9,448,702.

The Titan III launch facilities built at Cape Kennedy by the Corps of Engineers at a cost in excess of $55 million were part of a program to give the USAF its first complete launch system planned from the ground up for military space purposes. These facilities put to practical use, for the first time, an Integrate-Transfer-Launch concept for assembling space vehicles and moving them whole to launch sites.

Under the ITL system, the Titan III boosters are erected and mated with their payloads in an assembly area distant from their launch site, then transported in the vertical, or launch, configuration to the pads for final countdown and liftoff.

Principal elements of the ITL complex are:

a. Vertical Integration Building (VIB)
b. Solid Motor Assembly Building (SMAB)
c. Two launch pads, each with umbilical and service towers (Launch Complex 40 and 41)
d. Seven miles of railroad linking the assembly area and launch areas

The Titan III construction program was one of the first major projects of the Canaveral District. Two prime contracts were let for construction of these facilities which had been designed initially by the Ralph M.Parsons Company of Los Angeles. One of the construction contracts -- for $13.7 million -- was awarded in June 1963 to the joint venture of C. H. Leavell and Company and Peter Kiewit Sons Company of El Paso, Texas. It called for construction of the two launch complexes, pads 40 and 41. The other prime contract -- $23.7 million -- went to the teamed venture of Paul Hardeman, Inc., and Morrison-Knudsen Company, Inc., of Stanton, California, and was awarded in August, 1963. It called for construction of the Titan III assembly area buildings and the transporter tracking system.

Heart of the ITL system is the Vertical Integration Building (VIB) which stands 233 feet high and sits on an acre of dredged-up ground. It has four main bay areas for assembling Titan III boosters and their payloads. It has a ground floor area of 74,000 square feet and contains,

Dual-track railroad terminates at each assembly bay of Titan's Vertical Integrated Building, to give it multiple assembly and movement capability. Dual-track rails then move easily through center bay of Solid Motor Assembly Building. Concept also embodies two launch pads farther east. Eight-hour reaction time was military objective.

overall, more than five million pounds of structural steel. This integration, or assembly building, also contains the Launch Control Center for Titan III missions.

The Titan III may be used in two modes: the three-stage Titan III-A, an all-liquid fueled version which is put together wholly within the VIB and moved by rail directly to the launch pad; and the Titan III-C which is given added thrust from two solid rocket "strap-ons" to the main III-A core section. Installation of these solid rocket motors takes place in the Solid Motor Assembly Building (SMAB), located between the VIB and the launch pads and linked by a dual-track railway which runs dead-center through the SMAB to pick up the strap-on boosters. The SMAB equals the VIB in height (233 feet) and, with its giant doors retracted, straddles the tracks and moves a solid booster onto each side of the assembled main core, from assembly bays adjacent to the track corridor. An overhead bridge crane of 300-ton capacity, and with a hook-height of 180 feet, performs the chore of hoisting solid rocket motors into position for fastening to the Titan III core package.

A dual set of standard gauge railroad tracks is actually the lifeline of Titan III in any mode. Over the road, two 1,000-horsepower diesel-electric locomotives, one on each track, push the assembled Titan vehicles and their mobile launch platforms from the assembly area to one of the two launch pads, each of which has a concrete deck 23 feet high with the transporter track sloping up to the launch level.

It has been said that AGE is not a time of life, it's a state of mind. With those who designed Integrate-Transfer-Launch for the Titan III-C for the Corps of Engineers to build for the Air Force, AGE was a rather advanced state of mind. But it solved the problem of moving Assiciated Ground Equipment (AGE) right along with the Titan rocket package from Assembly point to launch pad.

The ITL, beginning with its Vertical Integration Building for the basic Titan core, does indeed move an entirely complete and fully integrated launch-package into position for rapid fueling, fast countdown and early liftoff, after assembly three miles away. And all of the Associated Ground Equipment (again we AGE) for the assembled vehicle is contained for the first time in four railroad cars which move along ahead of the Launch Vehicle and its Mobile Launch Platform to the firing area. These four railroad cars, crammed with all the essential electronic gear, instrumentation, computers and on-pad information essentials, are part and parcel of the Titan III from its assembly (which they monitor in a parked position in the VIB), throughout its rail-corridor movement into and through the SMAB (if it is to pick up strap-on solid boosters) and on to its launch area. At the pad itself, these four "nerve-center" railroad cars move snugly into a special garage at the base

Here Titan III core moves with pusher locomotives from VIB to SMAB for strap-on boosters and later transport to Pad 41. Corps delivered island-chain complex, railroads, launch pads to Air Force as operational on April 1965.

of the launch site, still connected in every critical particular to the missile itself up to the moment of launch.

By the time it reaches the firing site, a Titan III-C has already been "counted down" to near-launch readiness because of the constant link-up with AGE throughout the pre-assembly, assembly, and launch-placement process.

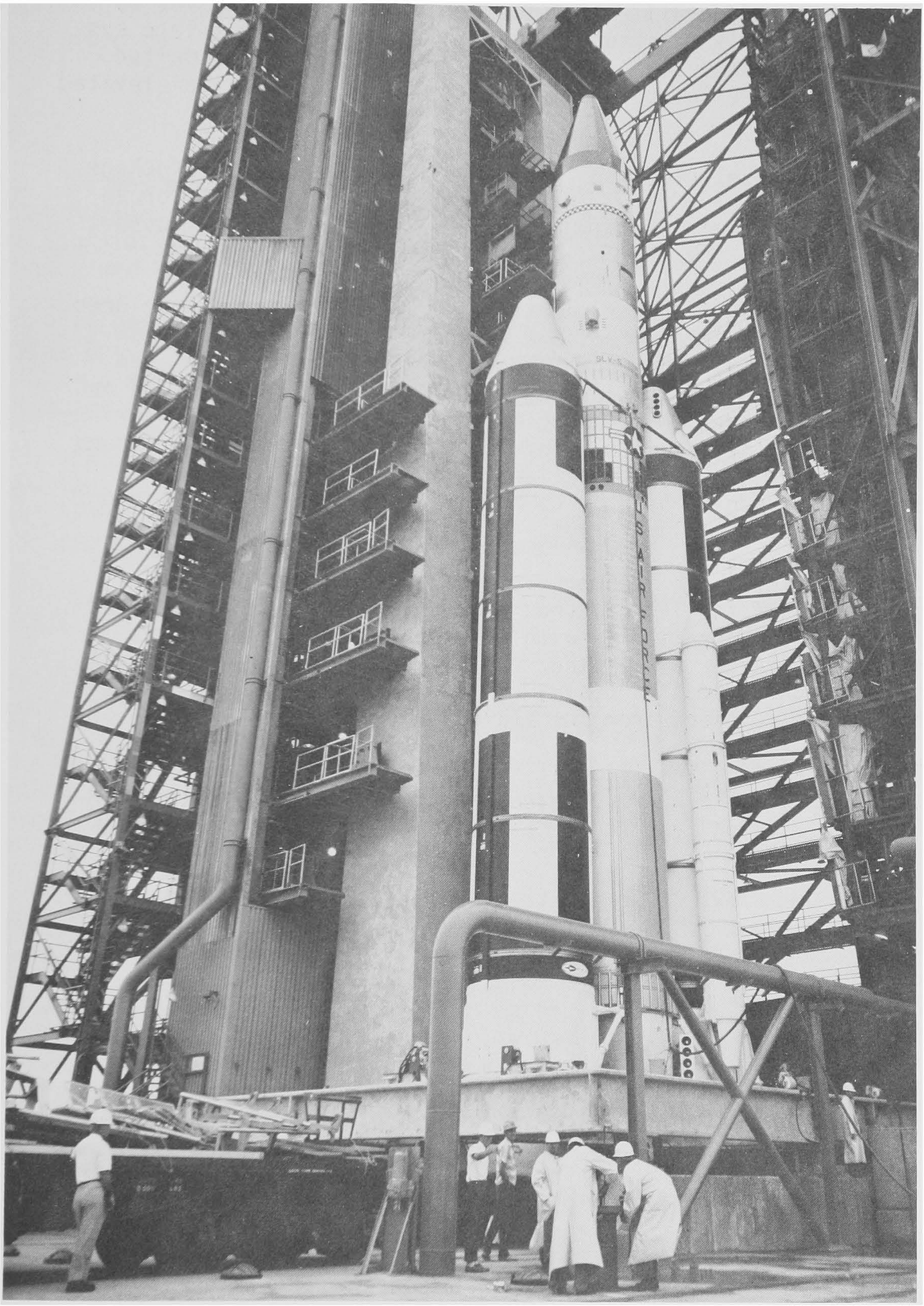
The entire Titan III-C sequence results in a launch-bundle of three teamed rockets, mounted on a mobile rail-riding launch platform, with four matched custom-built freight cars moving immediately ahead two-abreast, and with two veteran locomotives pushing the entire load from the point of its delightfully-mixed marriage to its moment of destiny.

The Titan's man-made nest in the Banana River includes a barge-canal approach for delivery of launch components, and has storage, checkout and pre-assembly buildings for all prime elements of the main-core and booster rocket segments. When the main-core (Titan III) is assembled in the Vertical Integration Building, all of its stages and operating elements have met on-site inspection certifying them flyable; the same is true of each segment of the strap-on solid boosters when they come together in the SMAB to join the Titan III (and make it a Titan III-C) on its route to the launch pad.

Anchored to each launch site is an umbilical tower, an all-steel frame structure extending 170 feet above the launch deck and containing 19 work platforms for final pre-launch checkouts of the Titan III-A or C configuration. A 240-foot tall Mobile Service Tower moves on rails between its rest or "park" position and the pad for servicing the launch vehicle. Thirty minutes prior to launch, this MST is withdrawn from the pad to its rest area 585 feet distant.

Construction of the rail system for Titan III began in January 1964 and was completed in January 1965. Because of the special task it was designed to perform, the system was built to one of the finest tolerances ever required of any railroad.

Unlike conventional railways, the main line is one continuous track fused together through a unique process known as thermite welding. This procedure uses a pre-fabricated mold which is placed around the tracks. A mixture of aluminum and magnesium is placed inside the mold and heated by means of gunpowder ignited via flint gun. Temperatures reach about 6,000 degrees during the process and, as the aluminum-magnesium mixture melts it filters through the bottom of the mold and forms around the track. After cooling, the mold is broken away and any minutely roughened edges are smoothed. The use of this thermite welding instead of conventional bolted joints



Titan III-C stands as a complete vehicle under service at Pad 41.

eliminates the slightest bump, the tiniest tremble, and practically precludes chance of derailment of the priceless cargo. As far as is known, this specially constructed trackage is the only complete system of its kind in the Southeast and one of the few in the United States -- it has been used in other sections for subways and elevated trains.

The three diesel-electric locomotives for Titan III's trackage (only two are used at a time, the third is back-up) are all Korean War veterans, specially modified for use in the Titan III transport process.

Although mainly used for short hauls, the locomotives have been equipped with a special control system which permits operation in four distinct modes: Transporter mode, used to smoothly haul the assembled space booster and payload at speeds between one-fourth mph and five mph; switched mode, using maximum power to move long strings of railroad cars; series mode, used for switching lighter loads such as flatcars carrying solid propellant segments; and automatic or standard mode, which is used by commercial locomotives for efficient highspeed operation on long trips.

To insure that both locomotives are perfectly coordinated during movement of the Titan launch package, the pair are connected electrically and pneumatically with a special boom. One unit is designated the "master", the other the "slave." Both units are then controlled as one, simultaneously, via the "master" by controllers who monitor the movement from the VIB control room.

The seven-mile Titan III rail system is connected by a spur line to NASA's 16-mile Kennedy Space Center railroad, which in turn ties into the Florida East Coast Railroad at Wilson, Florida.

CHAPTER VII

SOME HIGHLIGHTS AND A PHASEDOWN

On Monday, May 2nd, 1966, the Canaveral District entered its fourth year of operation with $392.9 million worth of construction to show for its first three years at Cape Kennedy, the Kennedy Space Center and Patrick AFB.

It was enough of a milestone to celebrate, and with a new District Engineer just arrived, there was about as much excuse for a stand-up buffet and cocktail party as anybody might need. So the District engineered one.

Col. W. L. Starnes, who had headed the District since September 1964 and had been with the Corps in the Cape area since 1962, had orders in his pocket for Viet Nam. Col. N. A. Lord had assumed the top spot on the District's third anniversary.

Over the three year period, the District had been putting new space-age construction in place at a rate of better than $490,000 worth each working day. In its first year alone, the Corps' District at Canaveral had placed or completed $119.4 million; in its second year $167.1 million; and in its third, $106.4 million. Highlighting this high-paced three-year span had been construction of the Air Force's Titan III launch system, Patrick Air Force Base medical facilities, design and construction of the VAB, two launch pads, the Mobile Service Structure at NASA's Complex 39 and design and construction of the KSC Industrial Area on Merritt Island.

On the May 1966 departure list along with Col. Starnes, was Col. Joseph A. Bacci, who for three years had held the key on-site post of Resident Engineer at NASA's Launch Complex 39 VAB Resident Office and had been nicknamed everything from "Moon" to "Crawlerway." He would now go to Saudi Arabia, to be replaced by Ralph I. Horne, who had been the Corps' prime mover on the Industrial Area. Mr. Horne had served as Resident Engineer of the West Resident Office since July 1963. He thus became Resident Engineer of the newly created Merritt Island Resident Office, which resulted from merger of the former West and VAB Resident Offices.

In the 12 months preceding this third anniversary, the Corps had celebrated other highlights. To name a few: completion of basic construction on the first moon launch pad in September; the topping out of the 525-foot Verticle Assembly Building in April;

the "closing in" of the VAB in September; topping out of the 400-foot Mobile Service Structure for Complex 39 in November; completion of modifications at Launch Complex 34 at Cape Kennedy (for NASA's Saturn 1-B program) in August, and substantial completion of alterations at Complex 37 for the same program in April.

Construction decline was now closely defined, but roughly 3,000 construction workers were still employed at the Cape, at KSC and elsewhere within the District's province (this figure had gone over 8,000 in 1964).

Key District assignments had been filled by Col. J. Newton Cox, Deputy District Engineer for NASA (later succeeded by Col. Robert L. Bangert)*, Lt. Col. Frank J. Vassalotti, Deputy District Engineer for Air Force, Lt. Col. William W. Hall, Jr., Project Manager for Communications and Electronics, Mr. Joseph L. Harvey, Chief, Engineering Division, and Mr. Donald E. Eppert, Chief, Construction Division.

Lt. Col. Remi O. Renier had been assigned as Resident Engineer of the Titan III Resident Office in June 1963, to oversee construction of launch facilities and related projects at the north end of Cape Kennedy. His office was physically located in the Space Systems Satellite Test Facility Building on the Cape, and to coordinate and execute the tight construction schedules, the Air Force Space Systems Division established a Civil Engineering Office in the same building, as did the Architect-Engineering firm (Ralph M. Parsons Co.) which designed the Titan III package, and the Martin Company, which had developed the Titan III vehicle. This common location permitted a level of liaison and close working relationships which were to benefit the Titan III project throughout. In September 1964, Col. Renier was assigned to the Canaveral District Office as Deputy District Engineer for Air Force Construction and Lt. Col. Leo J. Miller took on the Titan III Resident job. Upon completion of major construction for the Titan III System, Miller's office was closed out on 1 June 1965 and the South Resident Office, located at the south end of Cape Kennedy, took over the remaining work for Titan III and other Air Force, NASA and Navy construction on the Cape proper. Mr. Henry L. Freeman was Resident Engineer of the South Resident Office.

During fiscal 1967, the Canaveral District's overall construction volume "contracted for" declined to $60 million, and in October Col. Lord announced that the District would vacate its leased Headquarters Building on State Road 3, Merritt Island, and again relocate to Patrick AFB. He said the move was dictated by a need for greater economy in line with the decrease in District workload and the completion of all major facilities at the Kennedy Space Center. In mid-October 1967 there were 200 people employed in the District Headquarters, with another 140 assigned in field offices at Patrick, Cape Kennedy


NAVERAL DISTRICT
U.S. ARMY C
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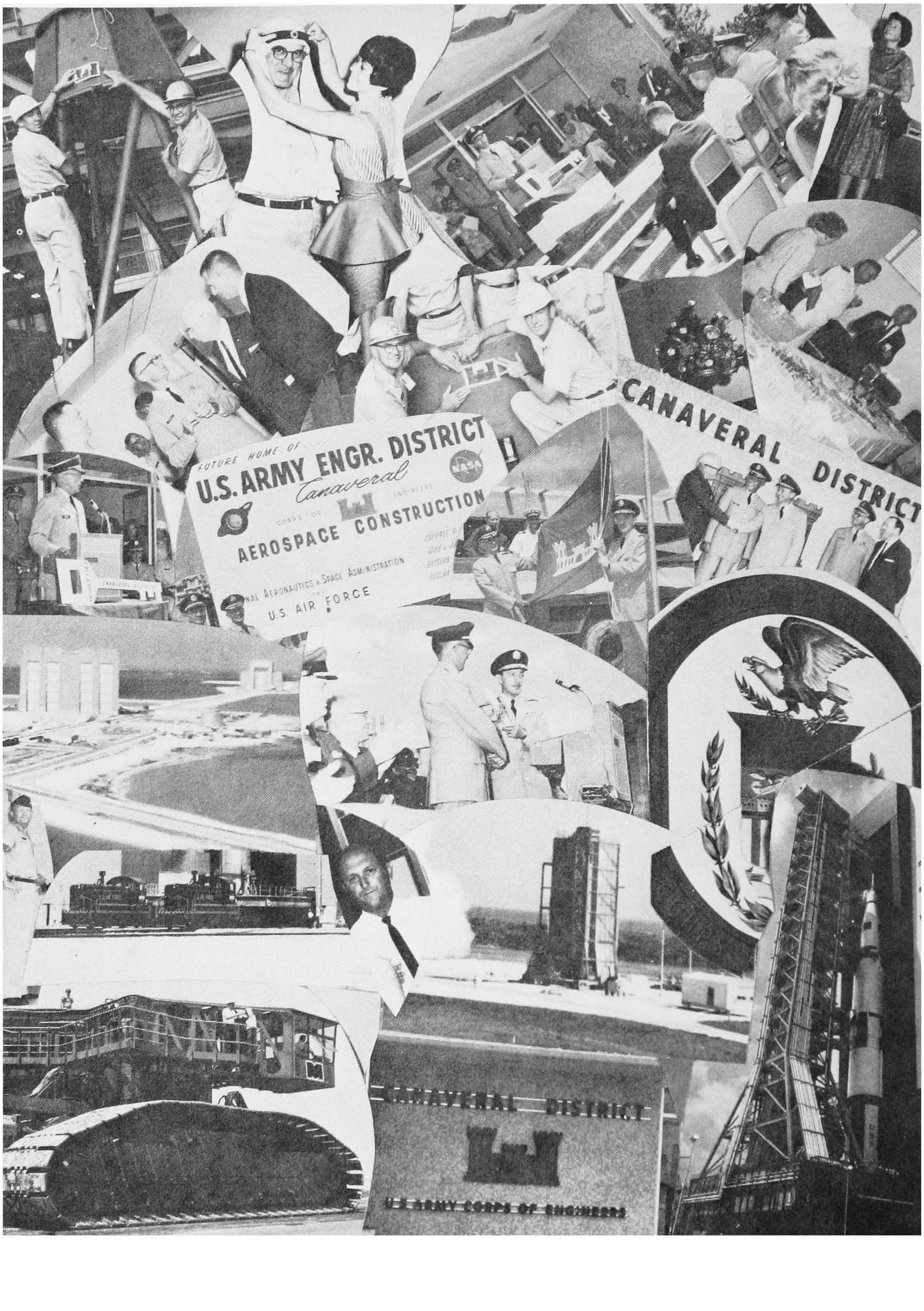
TO THE
E SNETZER
VIET NAM NEXT STOP
for
BILL STARNES
FOR


FUTURE HOME OF . . .
U.S. ARMY ENGR. DISTRICT
Canaveral
AEROSPACE CONSTRUCTION
U.S. AIR FORCE
CANAVERAL DISTRICT
CANAVERAL DISTRICT
U.S. ARMY CORPS OF ENGINEERS

and KSC. The total of 340 would further shrink to 320 by year's end.

Projects under Canaveral District supervision which were completed during Calendar 1967 included the second Apollo launch pad for NASA; the propellant Systems Components Laboratory Complex for Apollo; and operational intercommunications system for Launch Complex 39; a closed circuit television network for the Manned Spacecraft Operations Building in the KSC Industrial Area; additions to the Central Heating Plant, Flight Crew Training Building and Central Dispensary, all in the KSC Industrial area, and a guidance Telemetry Building for the Navy's Poseidon Missile program at Cape Kennedy.

When the District completed its relocation to Patrick in December 1967, it could foresee completion within the coming six months of other NASA and Defense-related projects: outfitting of High Bay 2 in the VAB; two Poseidon launch pads and a motor assembly building for the Navy at Cape Kennedy; modifications to Launch Complex 17 at the Cape for NASA's long tank Delta vehicles; additions to the KSC Headquarters Building, and a closed circuit television network for Launch Complex 39.

Between February and April 1968, the District trimmed its work force by another fifty people due to shrinking workloads. Most of those affected by the reduction were transferred to other Corps offices in the United States and overseas, and many had already been tabbed for positions with the then-new Huntsville Division, Corps of Engineers, at Huntsville, Alabama, which had been assigned design and construction responsibility for the nation's Sentinel (anti-ballistic missile) program.

From $60 million in fiscal 1967, the District's work placement for NASA and Defense agencies declined to $33.1 million in fiscal 1968, and to $17.8 million in fiscal 1969. This falloff was matched by personnel declines which continued apace right up to District deactivation:

Date	Dist. Strength
30 June 1968	180
1 Aug 1969	163
15 Oct 1969	149
5 Jan 1970	120
1 Aug 1970	55
1 Nov 1970	36
30 June 1971	12

Beginning in February 1970, Personnel Services were rendered by the Jacksonville District and were then assumed by the Mobile District in August, as were other functions including Safety, Office of Counsel and Administrative functions. Removal of the Canaveral District offices from Patrick AFB to the Kennedy Space Center was effective 1 August 1970.

During this period of contraction, Corps veteran Col. Gilbert H. Newman arrived from the Imperial Defense College in London, England, to succeed Col. N. A. Lord as District Engineer in January 1969. Col. Lord was reassigned as Professor of Military Science and Tactics at Clarkson College, Potsdam, New York.

Lt. Col. V. D. Stipo became District Engineer on 1 November 1970 when Col. Newman was assigned to the Army General Staff.

General Orders No. 7, dated 22 March 1971 directed that the Canaveral District be discontinued effective 30 June 1971. Accordingly, deactivation ceremonies were held on the morning of 30 June on grounds adjacent to the District Office Building at Kennedy Space Center, with the Chief of Engineers and others from Washington in attendance, along with representatives from NASA, the Air Force, other agencies, and some 80 to 85 former employees of the Canaveral District. The ceremony was held in front of a modest, temporary type headquarters, with NASA's imposing Vehicle Assembly Building in the immediate background, its vast doors yawning wide, and with a Saturn V standing on Pad 39, being readied for the next United States launch of men to the moon.

On this occasion, Orders were read activating the Florida Area Office under the Mobile District, Corps of Engineers. The new Florida Area Office mission: supervision of construction at Homestead, MacDill and Patrick Air Force Bases, at Cape Kennedy, and the John F. Kennedy Space Center, NASA.

DEACTIVATION CEREMONEY

LTC V. D. Stipo, District Engineer, Canaveral

LTG F. J. Clarke, Chief of Engineers

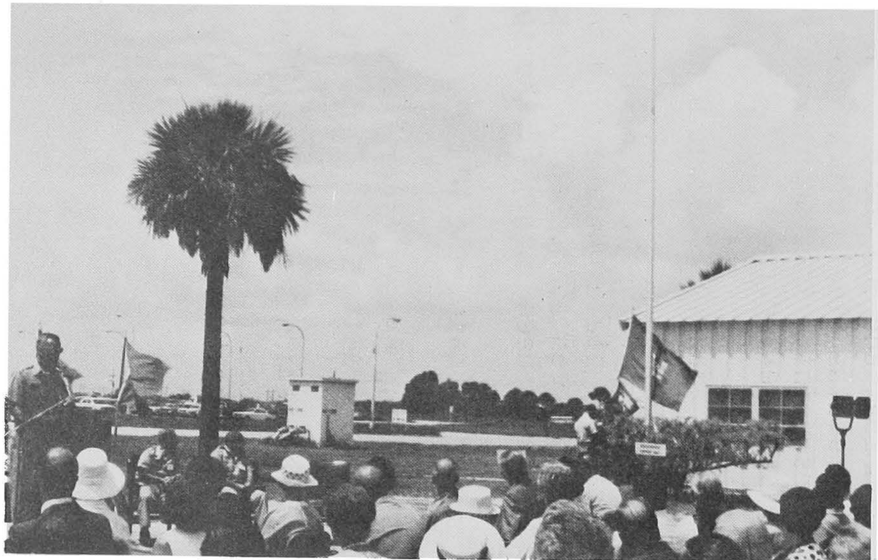
MG W. L. Starnes, Division Engineer, Cincinnati

Dr. Kurt Debus, Director, KSC, NASA

DEACTIVATION CEREMONEY

Col. Robert W. Hoffman. Vice Commander. ETR. PAFB

Guests attending Deactivation Ceremony



Lowering of the District Flag

Presenting flag to Chief of Engineers

POSTSCRIPT

You don't stake out and preserve Lindbergh's runway. You put a plaque there. You put his "Spirit of St. Louis" in the Smithsonian Institution, and you mark the ground, like Kittyhawk.

Real Estate, everywhere, is all that critical. At Cape Kennedy -- the most ideal launch-site man could find when the space-age dawned -- real estate is often more than "all that critical", but sometimes less.

In 1964, when the Canaveral District was in its heaviest pulse of construction activity for NASA and the USAF, the umbilical tower that had serviced John Glenn's flight (the first American in orbit) was dismantled at famed Pad 14, and the Corps put a new one in its place to accommodate Atlas Agena.

Glenn had been followed from Pad 14 by Scott Carpenter, Wally Schira and Gordon Cooper during the pioneering Project Mercury program.

There is a plaque by the access road that says so.

After Atlas Agena, Pad 14 was deactivated.

Other launch complexes built by the Corps of Engineers at Cape Kennedy and now dismantled include Pads 1, 2, 3, 4, 11, 15, 18A and B, 20, 25A, and 30A and B. Many others have been retired to inactive status, their blockhouses serving in support roles as communications points, instrumentation sites, service and storage places -- or else deserted.

Pads 5 and 6, 26A and B are official museum locations.

Other launch sites, having served their purposes, sit now on stand-by status -- awaiting the need, and the nod, of the future. Some have been abandoned to the still very short history (or has it by haste been long?) of the space age.

In any case, the plaques are there.

And the newer, finer, more advanced and sophisticated points of action are there.

The nation's first tentative step into space was there.

And the U. S. Army Corps of Engineers naturally enough, was there.

APPENDIX "A"

BIOGRAPHICAL DATA AND PHOTOGRAPHS

of

DISTRICT ENGINEERS

CANAVERAL DISTRICT

1963 - 1971


FINLEY

District Engineer
May 1963 - September 1964

COLONEL G. A. FINLEY

Colonel G. A. Finley for 27 years a commissioned officer in the U. S. Army Corps of Engineers, had been District Engineer at the Canaveral District since its creation on May 1,1963.

The Canaveral District, which Colonel Finley headed, was in charge of the Cape Canaveral and Merritt Island construction programs for the Air Force and the National Aeronautics and Space Administration.

Among the projects under Colonel Finley's responsibility were the $400 million Saturn V moon-launch facility for NASA and the $40 million Air Force Titan III construction program.

Colonel Finley had been post engineer at Fort Knox, Ky., for three years before going to Cape Canaveral.

A 48-year-old native of Philadelphia, Colonel Finley received his commission in the Corps of Engineers upon graduation from the U. S. Military Academy at West Point in 1936.

Colonel Finley served in World War II with the 47th Regiment in the Pacific Area. He was Assistant G-3, United States Forces of the Pacific Area, with headquarters at Fort Shafter, Hawaii. Later, he was Executive Officer, Operations Division, United States Army Forces, Mid-Pacific Area. After the war, he served for three years as Executive Officer to the Assistant Chief of Engineers for Military Operations, Washington, D. C. He attended the Armed Forces Staff College, Norfolk, Va., and served for a short period as Executive Officer, Portland, Oregon, Oregon District, then, for three years was District Engineer, Rock Island, Ill.

From 1953 to 1956, Colonel Finley was again assigned to the Office of the Chief of Engineers, Washington, D.C. He served under the Assistant Chief of Engineers for Military Construction, first as assistant for plans, then as executive, and later as assistant for Air Force construction.

Colonel Finley was District Engineer, Okinawa District, from 1956 to 1957, and then served for a year on the staff of the Engineer School, Fort Belvoir, Va. Following a year at the Army War College, Carlisle Barracks, Pa., he went to his assignment at Fort Knox, Ky.

District Engineer
September 1964 - May 1966

COLONEL W. L. STARNES

As Canaveral District Engineer, Colonel W. L. Starnes was responsible for the design and construction of more than $300 million in aerospace facilities for the Air Force and the National Aeronautics and Space Administration in the Cape Kennedy-Merritt Island-Patrick Air Force Base area of Florida.

Principal among the construction programs directed by Colonel Starnes were the Apollo-Saturn V moon launch facilities on Merritt Island for NASA's program to land astronauts on the moon by 1970. Colonel Starnes also headed construction of the launch structures needed by the Air Force for the launch system of its Titan III standard space booster at Cape Kennedy.

Colonel Starnes came to the nation's space center in the fall of 1962 and assisted in the creation and activation of the Canaveral District of the Corps of Engineers on 1 May 1963. Prior to assuming command as District Engineer on 1 September 1964, Colonel Starnes was Deputy Canaveral District Engineer for NASA construction. In this position he was intimately concerned with the moon launch facilities from their design phase through the first 20 months of construction.

Colonel Starnes is a graduate of the U. S. Military Academy at West Point and holds a master's degree in civil engineering from Massachusetts Institute of Technology and a master's degree in business administration from George Washington University.

He is a registered engineer in the States of Texas and New York

Among his previous military assignments, Colonel Starnes was in charge of construction of NIKE Hercules sites at Thule Air Force Base, Greenland, as well as construction of ballistic missile early warning sites there.

Before coming to the Canaveral District, Colonel Starnes was a staff officer in the organization of the Joint Chiefs of Staff in Washington, D. C.


U.S.
U.S.

District Engineer
May 1966 - January 1969

COLONEL N. A. LORD

Colonel N. A. Lord, who became the new Canaveral District Engineer for the U. S. Army Corps of Engineers in early May 1966, served as Deputy District Engineer for Kennedy Space Center Construction on Merritt Island prior to that time.

Colonel Lord came to the Canaveral District in January 1966 from Izmir, Turkey, where he was assigned for two years as Chief of the Engineering Division at NATO Headquarters.

As District Engineer, he succeeded Colonel W. L. Starnes, who was assigned to the 18th Engineer Brigade in Viet Nam.

A Corps officer for 19 years, Colonel Lord is a native of Ogdensburg, New York. He was called to duty as a reserve officer in the Corps of Engineers in 1941. In 1942, he transferred to the Army Air Corps and during the remainder of World War II was a medium bomber pilot and instructor in the Air Corps Flight Training Command.

Colonel Lord was commissioned in the Regular Army, Corps of Engineers, in 1947. Since then he has served overseas assignments in Korea, Japan, England and Turkey. Among his assignments in this country was a two-year tour of duty as Assistant New England Division Engineer in Boston, Massachusetts.

Colonel Lord holds a bachelor of science degree in civil engineering from Clarkson College of Technology at Potsdam, New York, and a master's degree from Ohio State University. He has attended both the Command and General Staff College at Fort Leavenworth, Kansas, and the Army War College at Carlisle Barracks, Pennsylvania. He is a registered professional engineer in Massachusetts and Kansas.


U.S.

District Engineer
January 1969 - November 1970

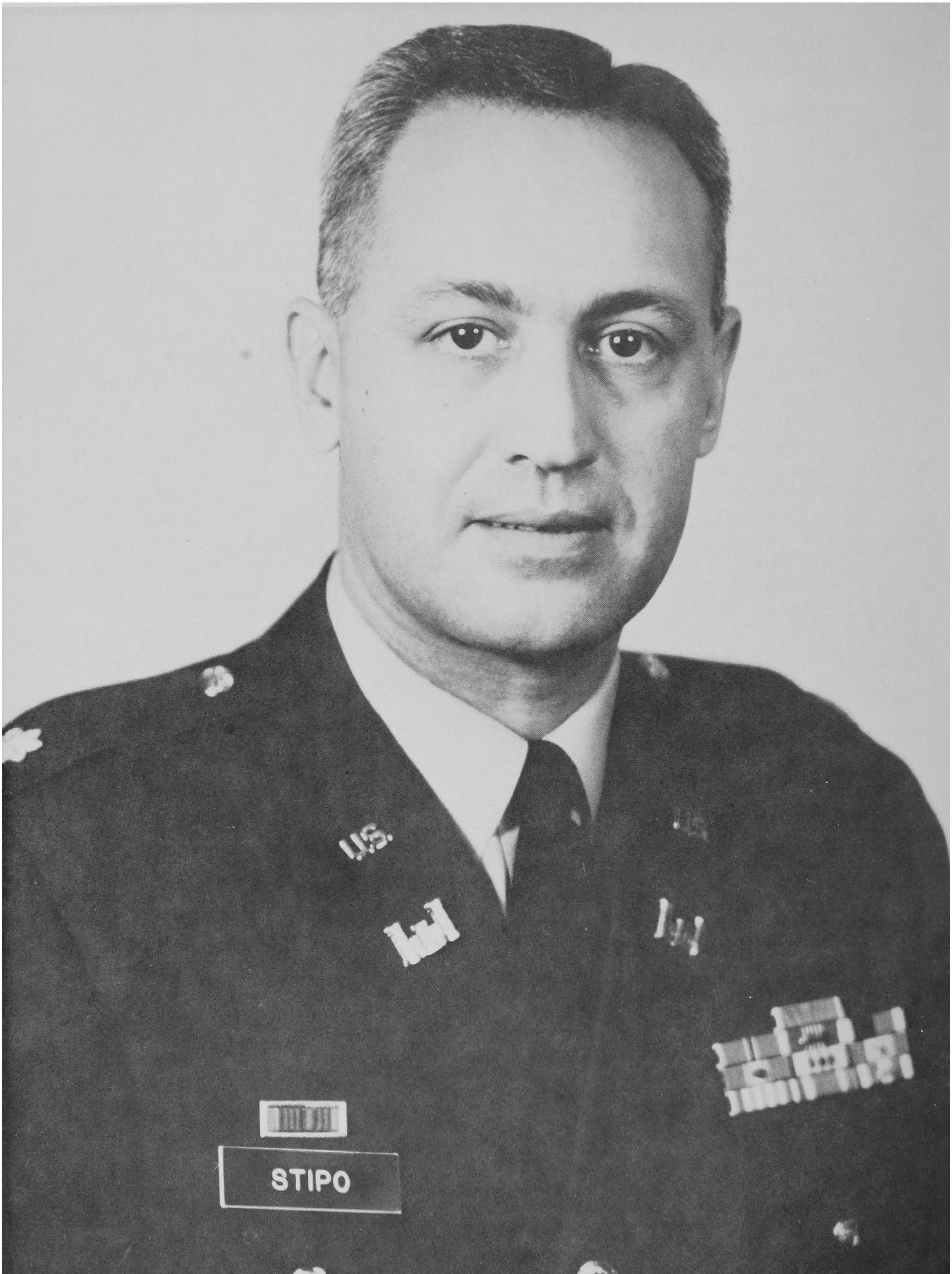
COLONEL G. H. NEWMAN

Colonel G. H. Newman became Canaveral District Engineer of the U. S. Army Corps of Engineers on January 27, 1969.

Colonel Newman came to the Canaveral District in January 1969 from London, England, where he had attended the Imperial Defense College.

As District Engineer, Colonel Newman was responsible for the design and construction of aerospace facilities for the Department of Defense and NASA in the Cape Kennedy - Kennedy Space Center - Patrick Air Force Base area in Florida. Principal among the engineering and construction programs were those concerned with Apollo-Saturn V moon launch facilities at the Kennedy Space Center for NASA's program to land astronauts on the moon. Colonel Newman was also responsible for Canaveral District projects in support of the Air Force and Navy aerospace programs at Cape Kennedy and Patrick Air Force Base. A Corps officer for 26 years, Colonel Newman is a native of Shreveport, Louisiana. He was called to active duty as a reserve officer in the Corps of Engineers in September 1941 and served in the Southwest Pacific Theater of Operations during World War II. He was commissioned in the Regular Army, Corps of Engineers, in 1948. Since then he has served overseas assignments in Korea, Japan, Germany, Viet Nam and England. For two years, 1956-1958, Colonel Newman was assigned to the Chicago District, initially as Executive Officer and later as Deputy District Engineer. For three years, he was assigned to the Special Weapons project, first in Albuquerque, New Mexico and subsequently at Killeen Base, Texas.

Colonel Newman holds a Bachelor of Science Degree in Petroleum Engineering from Louisiana State University, Louisiana, and a Masters Degree in Civil Engineering from Texas A&M College, College Station, Texas. He is a registered professional engineer in Texas and a member of the Society of American Military Engineers.


STIPO

District Engineer
1 November 1970 - June 30, 1971

LTC VITO D. STIPO

LTC Vito D. Stipo, son of Domenico and Antonetta Stipo, [redacted], in Brooklyn, New York. After completing Boys High School in Brooklyn, he attended Pennsylvania Military College where he was awarded a Bachelor of Science degree in Civil Engineering in 1952.

After graduation from PMC he entered the Corps of Engineers as a Second Lieutenant and served with a construction battalion in France and Germany. This assignment was followed by a tour at the Engineer School as an instructor in Roads and Airfields.

During 1956 to 1957, he attended Iowa State University where he was awarded a Master of Science degree in Civil Engineering. Assignment as Assistant Professor of Military Science at Northeastern University preceded a tour in Greenland where he served as Resident Engineer on the construction of a Dewline Radar Station on the island of Kulusuk. In 1961 he joined the 79th Engineer Construction Group as Engineering Officer. This assignment was followed by a tour as Commander of the 73rd Engineer Company (Construction Support).

From 1963 to 1966 he served at Verona, Italy, with the Southern European Task Force as Chief, Facilities, Construction and Installation Division. Following graduation from the U. S. Army Command and General Staff College in 1967, he was assigned as the Facilities Officer for the Chief of Research and Development, Department of the Army. Assigned to Viet Nam in 1969 he assumed command of the 36th Engineer Construction Battalion, where he served for a year directing heavy construction in support of the combat operations. Prior to coming to Canaveral, LTC Stipo was Director of Facilities at the U. S. Army Topographical Command.

LTC Stipo is a registered professional engineer in the State of Vermont and a member of the National Society of Professional Engineers; a member of the Society of American Military Engineers; and a member of the Knights of Columbus. He has been awarded the Legion of Merit, Bronze Star, and Army Commendation Medal with two oak leaf clusters. The Republic of Viet Nam awarded him the Corps of Gallantry, Medal of Honor 1st Class and the Public Works Medal.

APPENDIX "B"

ORGANIZATIONAL CHARTS

PATRICK AREA OFFICE

AND

CANAVERAL DISTRICT

1963 - 1971

U.S. ARMY ENGINEER DISTRICT, JACKSONVILLE

EXECUTIVE OFFICE

FIELD OFFICE

AREA OFFICE - PATRICK AFB, FLA.

COL. W. L. STARNES, CE	Area Engineer
D. E. EPPERT	Deputy Area Engineer
Supv Const Engr (Gen)	GS-15
W. E. HERIG	Asst to Area Engineer
Supv Const Mgmt Engr (Gen)	GS-13
E. R. BRAMLITT	Asst to Area Engineer
Const Mgmt Engr (Gen)	GS-13
1 Clk-Steno	GS-4

SPECIAL ASSISTANT

CAPT. P. A. WOOLAVER, CE
Special Projects Officer

ENGINEERING BRANCH

S. B. PRESSON	Chief
Supv Const Engr (Gen)	GS-13
1 Supv Const Mgmt Engr	GS-12
3 Mech Engr (Gen) (1-V)	GS-11
2 Elec Engr (1-V)	GS-11
2 Struc Engr (1-V)	GS-11
1 Civ Engr Tech	GS-7
1 Clk Design Status	GS-4
1 Clk-Steno	GS-4

ADMINISTRATIVE BRANCH

J. H. DAVIS	Chief
Supv Admin Aid	GS-10
W. R. GANO	Asst Chief
Supv Admin Asst	GS-8
W. H. McCRACKEN	Asst Chief
Admin Asst	GS-8
1 Admin Asst	GS-7
1 Clk (Typg)	GS-5
2 Clk	GS-5
1 Clk-Steno	GS-4
6 Clk-Typist (2-V)	GS-3
1 Chauffeur	W-5
1 Repro Equip Opr	W-4
2 Laborer	W-2

OFFICE OF COUNSEL

M. M. CROOK	Chief
General Attorney	GS-12
1 Labor Rel Asst	GS-9
1 Labor Rel Clk	GS-6

SAFETY BRANCH

(V)	Chief
Safety Engineer	GS-12

CONSTRUCTION BRANCH

A. H. BRANCH	Chief
Supv Const Engr (Gen)	GS-13
J. D. WEESE	Asst Chief
Const Engr (Gen)	GS-12
1 Quality Control Spec	GS-12
1 Mech Engr (Gen)	GS-12
1 Elec Engr (Gen)	GS-12
4 Const Engr (Gen) (1-V)	GS-11
1 Mech Engr (Gen)	GS-11
1 Elec Engr (Gen) (V)	GS-11
1 Const Engr (Gen)	GS-9
1 Surv Tech	GS-9
2 Const Engr Tech (1-V)	GS-9
1 Civil Engr	GS-9
1 Const Insp (Gen)	GS-8
1 Const Engr	GS-7
1 Exp & Prior Asst	GS-7
5 Const Insp (Dredging)	GS-7
5 Const Insp (Earthwork)	GS-7
2 Const Insp (Roadways) (1-V)	GS-7
1 Clk (Exp & Prior)	GS-5
1 Mats Engr Aid	GS-4
2 Civil Engr Aid	GS-4
1 Const Engr Aid	GS-4
1 Clk-Steno	GS-4
1 Clk-Typist	GS-3

PATRICK AFB RESIDENT OFFICE

R. D. HARPER	Resident Engr
Supv Const Engr (Gen)	GS-11
1 Const Engr (Gen)	GS-11
1 Const Engr Tech	GS-11
1 Elec Insp (V)	GS-9
1 Mech Engr (Gen)	GS-9
1 Clk (V)	GS-4

CONTRACT ADMINISTRATION BRANCH

C. S. MOORE	Chief
Supv Const Mgmt Engr (Gen)	GS-13
L. H. STRUNK	Asst Chief
Supv Const Mgmt Engr (Gen)	GS-12
1 Const Mgmt Engr (Gen)	GS-12
1 Supv Const Mgmt Engr (Gen)	GS-12
4 Const Mgmt Engr (Gen) (3-V)	GS-11
1 Elec Engr (Gen)	GS-11
2 Const Engr Tech	GS-11
1 Mech Engr (Gen)	GS-11
3 Const Mgmt Engr (Gen)	GS-9
1 Engr Tech	GS-9
1 Engr Tech	GS-6
1 Contr Mod Clk	GS-6
1 Clk (Typg)	GS-5
1 Clk-Steno	GS-4
3 Clk-Typist (1-V)	GS-3

SOUTH RESIDENT OFFICE - CCMTA

H. L. FREEMAN	Resident Engr
Supv Const Engr (Gen)	GS-13
1 Supv Const Engr (Gen)	GS-12
7 Const Engr (Gen)	GS-11
2 Elec Engr (Gen)	GS-11
2 Mech Engr (Gen)	GS-11
1 Const Rep (Bldg & Util)	GS-11
1 Const Engr Tech	GS-11
1 Elec Engr Tech	GS-11
1 Const Rep (Gen)	GS-11
3 Mech Engr Tech	GS-11
7 Elec Insp (1-V)	GS-9
4 Mech Insp	GS-9
1 Const Engr Tech	GS-9
4 Const Engr (Gen)	GS-9
2 Const Insp (Gen)	GS-8
3 Civil Engr Tech	GS-7
2 Const Engr	GS-7
1 Elec Engr	GS-7
3 Const Insp (Roadways)	GS-7
1 Clk	GS-6
1 Clk	GS-4
1 Const Engr Aid	GS-4

WEST RESIDENT OFFICE

(V)	Resident Engr
Supv Const Engr (Gen)	GS-12
1 Mech Insp (V)	GS-9
1 Elec Insp (V)	GS-9
1 Const Insp (Gen) (V)	GS-8
1 Clk (V)	GS-4

2 Military
156 Graded
4 Ungraded

1 January 1963

Reports Control Symbol
ENGEP-C-1

DISTRICT OFFICE

U. S. ARMY ENGINEER DISTRICT, CANAVERAL

EXECUTIVE OFFICE

COL. G. A. FINLEY, CE — District Engineer
Rm 210A Ext 203 — SACVE

COL. W. L. STARNES, CE — Dep. District Engineer NASA
Rm 210B Ext 206 — SACVE-NASA

COL. J. NEWTON COX, CE — Dep. District Engineer AF
Rm 210C Ext 200 — SACVE-AF

(a*)(Vacant) — Asst. District Engineer
Rm 210D Ext 204 — SACVY

E. R. BRAMLITT — Executive Assistant
Rm 210 Ext 205 — SACVX

(Vacant) — Asst. to Dep. Dist. Engr. NASA
Rm 210B Ext 207 — SACVE-NASA

(Vacant) — Asst. to Dep. Dist. Engr. AF
Rm 210C Ext 201 — SACVE-AF

(Vacant) — Administrative Assistant AF
Rm 210C Ext 202 — SACVE-AF

1 Secy (Stenography) — SACVE
Rm 210 Ext 203
1 Secy (Stenography) — SACVE-NASA
Rm 210 Ext 206
1 Secy (Stenography) — SACVE-AF
Rm 210 Ext 200

Street Address:
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Mail Address:
P. O. Box 1042, Merritt Island, Florida
Telephone:
NE 2-2510 Merritt Island, Florida

4 Military
7 Graded
0 Ungraded

SPECIAL ASSISTANTS

(a*) (Vacant) — SACVY
Emergency Operation Planner
Rm 210D Ext 204

(b*) F. GREENE — SACVL
Dist Labor Relations Officer
Rm 206 Ext 211

(c*) H. L. ALLEN — SACKS-1
Small Business & Labor Surplus Advisor
Rm 205 Ext 316

R. S. STUDT — SACVI
Intell. & Security Officer
Rm 120 Ext 454

1 Clerk-Typist
Rm 120 Ext 454

2 Graded
0 Ungraded

BOARDS & COMMITTEES

Incentive Awards Committee

Grievance Examiners

ADMINISTRATIVE SUPPORT

AFRCE

NASA

ADVISORY AND ADMINISTRATIVE STAFF

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Rm 115 Ext 423 — SACVC

TONIE A. REEVE — Asst. to Compt. for Int. Review
Rm 115 Ext 338 — SACCA

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Rm 115 Ext 339 — SACCM

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Rm 113 Ext 244 — SACCF

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W. H. McCRACKEN — Chief
Rm 113 Ext 233 — SACCP

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(Vacant) — Chief
Rm 115 Ext 338 — SACCB

PAGE 4

TECHNICAL LIAISON BRANCH

(Vacant) — Chief
Rm 209 Ext 288 — SACVT

PAGE 4

SAFETY BRANCH

L. U. FLEMING — Chief
Rm 207 Ext 214 — SACV

PAGE 4

OFFICE OF COUNSEL

EMIL VUCH — Chief
Rm 208 Ext 211 — SACVL

PAGE 5

PERSONNEL OFFICE

*GEORGE H. HEMBREE — Chief
Rm 118 Ext 237 — SACVP

MANPOWER MANAGEMENT BRANCH

*GEORGE H. HEMBREE — Chief
Rm 118 Ext 237 — SACVP

EMPLOYMENT & SERVICES BRANCH

CURTIS THORNTON — Chief
Rm 116 Ext 239 — SACPE

POSITION & PAY MANAGEMENT BR

THOMAS A. SHAW — Chief
Rm 114 Ext 240 — SACPP

PAGE 5

OFFICE OF ADMIN. SERVICES

J. H. DAVIS — Chief
Rm 109 Ext 442 — SACVO

PAGE 5

* Dual Assignment

(a) Assistant District Engineer and Emergency Operation Planner.

(b) District Labor Relations Officer and see Office of Counsel.

(c) Small business and Labor Surplus Advisor and see Construction Division.

SEE FOLLOWING SHEET

1 July 1963

SEE PRECEDING SHEET

DISTRICT OFFICE

TECHNICAL

ENGINEERING DIVISION
J. L. HARVEY — Chief
Rm 232 Ext 220 — SACVG

W. B. TURPIN — Asst. Chief
Rm 230 Ext 220 — SACVG-1

SURVEY BRANCH
J. M. SHIELDS — Chief
Rm 131 Ext 433 — SACGS

FOUNDATIONS & MATERIALS BR.
P. H. SHEA — Chief
Rm 138 Ext 363 — SACGF

DESIGN BRANCH
J. P. COONY — Chief
Rm 237 Ext 300 — SACGB

PLANNING & REPORTS BRANCH
F. A. GRASIER — Chief
Rm 235 Ext 218 — SACGP

A-E CONTRACTS BRANCH
(Vacant) — Chief
Rm 233 Ext 429 — SACGA

PAGES 6 & 7

STAFF

CONSTRUCTION DIVISION
D. E. EPPERT — Chief
Rm 204 Ext 317 — SACVK

R. T. QUICK — Asst. Chief
Rm 202 Ext 317 — SACVK-1

ENGINEERING CONTROL BRANCH
C. S. MOORE — Chief
Rm 211 Ext 320 — SACKC

CONSTRUCTION SERVICE BRANCH
J. D. WEESE — Chief
Rm 205 Ext 316 — SACKS

CONTRACT ADMINISTRATION BR.
P. G. HORD — Chief
Rm 212 Ext 334 — SACKA

DISTRICT LABORATORY
J. A. WOODRUFF — Chief
Rm 215 Ext 326 — SACKL

PAGE 8

SUPPLY DIVISION
A. C. HUTCHERSON — Chief
Rm 110 Ext 216 — SACVN

CONTRACT BRANCH
F. MOREHOUSE — Chief
Rm 108 Ext 258 — SACNA

MATERIALS CONTROL BRANCH
E. H. CASH — Chief
Rm 108 Ext 256 — SACNM

PROCUREMENT BRANCH
E. A. McKINLEY — Chief
Rm 108 Ext 257 — SACNC

PAGE 9

FIELD OFFICES

FIELD OFFICES

TITAN III RESIDENT OFFICE
LT. COL. R. O. RENIER — Res. Engr.
Tele 853-3479 — SAC-TRO

PAGE 10

PATRICK RESIDENT OFFICE
ROBERT D. HARPER — Res. Engr.
Tele UL 7-2225 — SAC-PRO

PAGE 10

VAB RESIDENT OFFICE
LT. COL. J. A. BACCI — Res. Engr.
Tele UL 7-7269 — SAC-VRC

PAGE 10

WEST RESIDENT OFFICE
RALPH I. HORNE — Res. Engr.
Tele UL 3-8610 — SAC-WRO

PAGE 11

SOUTH RESIDENT OFFICE
H. L. FREEMAN — Res. Engr.
Tele UL 3-2343 — SAC-SRO

PAGE 11

GRAND TOTAL
6 Military

497 Graded
40 Ungraded
537 Civilian

1 July 1963

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District Office

U. S. ARMY ENGINEER DISTRICT, CANAVERAL

EXECUTIVE OFFICE

COL. W. L. STARNES, CE — District Engineer
Rm 210A Ext 203 — SACVE

COL REMI O. RENIER, CE — Dep Dist Engr (MI)
Rm 210B Ext 206/207 — SACVE (MI)

LT COL F. J. VASSALOTTI, CE — Dep Dist Engr (CK-PAFB)
Rm 210C Ext 200/201 — SACVE (CK-PAFB)

E. R. BRAMLITT — Executive Assistant
Rm 210 Ext 205 — SACVX

C. G. TIERSCH, JR. — Asst to Dep Dist Engr (MI)
Rm 210B Ext 208 — SACVE (MI)

W. G. BIRDSONG — Asst to Dep Dist Engr (CK-PAFB)
Rm 210C Ext 201/202 — SACVE (CK-PAFB)

1 Secretary (Stenography) — SACVE
Rm 210 Ext 203
1 Secretary (Stenography) — SACVE (MI)
Rm 210 Ext 206/207/208
1 Secretary (Stenography) — SACVE (CK-PAFB)
Rm 210 Ext 200/201/202

COM'L & ELCT PROJ MGR'S OFFICE

W. W. HALL, JR. — SACEC
Lt Col SigC
Project Manager
Rm 207 Ext 475/76

C. E. VOGEL, JR. — SACEC
Maj SigC
Asst Project Manager
Rm 207 Ext 475/76

1 Secretary (Stenography) — SACEC
Rm 207 Ext 475/76

SPECIAL ASSISTANTS

* R. S. STUDT — SACVI
Emergency Operation Planner
Rm 137 Ext 312/13

(a*) F. GREENE — SACVL
Dist Labor Relations Officer
Rm 207 Ext 213

WALDEMAR J. LENCZEWSKI — SACEM
Project Manager
Rm 215 Ext 403

(b*) F. MOREHOUSE — SACNA
Small Business & Labor Surplus Advisor
Rm 108 Ext 258

* R. S. STUDT — SACVI
Security Officer
Rm 137 Ext 312/13

(c*) 1 Clerk-Stenographer — SACVI
Rm 137 Ext 312/13

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Incentive Awards Committee
Board of Architectural Review
Contract Termination Board
Junior Engr.' Trng. Committee

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T. A. REEVE — Asst. to Compt. for Int. Review
Rm 113 Ext 233 — SACCA

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G. C. HEIM — Chief
Rm 115 Ext 338 — SACCB

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F. H. EVANS — Chief
Rm 113 Ext 244 — SACCF

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J. E. VICK, JR. — Chief
Rm 115 Ext 339 — SACCM

PROPERTY ACCTG. BRANCH
W. H. McCRACKEN — Chief
Rm 113 Ext 233 — SACCP

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TECHNICAL LIAISON OFFICE
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Rm 210-D Ext 288 — SACVT

PAGE 4

SAFETY OFFICE
L. U. FLEMING — Chief
Rm 137 Ext 313 — SACVS

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E. VUCH — District Counsel
Rm 208 Ext 211 — SACVL

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OFFICE OF ADMIN. SERVICES
H. J. ROWAN — Chief
Rm 107 Ext 448 — SACVO

PAGE 5

PERSONNEL OFFICE
*G. H. HEMBREE — Chief
Rm 118 Ext 237 — SACVP

EMPLOYMENT & SVCS. BR.
T. A. SHAW — Chief
Rm 118 Ext 239 — SACPE

MANPOWER MGMT. BR.
*G. H. HEMBREE — Chief
Rm 118 Ext 237 — SACVP

POSIT. & PAY MGMT. BR.
A. A. GREELEY — Chief
Rm 120 Ext 455 — SACPP

PAGE 5

* Dual Assignment

(a*) See Office of Counsel, Page 5

(b*) See Supply Division, Pages 2 and 9

(c*) See Safety Office, Page 4

SEE FOLLOWING SHEET

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2575 North Courtenay Pike, Merritt Island, Florida ZIP 32952
MAIL ADDRESS:
P. O. Box 1042, Merritt Island, Florida ZIP 32952
Telephone:
632-2510 Merritt Island, Florida

APPROVED:
W L Starnes
W. L. STARNES, COLONEL, CE
DISTRICT ENGINEER

1 August 1965

SEE PRECEDING SHEET

DISTRICT OFFICE

TECHNICAL STAFF

ENGINEERING DIVISION
J. L. HARVEY — Chief — Rm 230 Ext 220 — SACVG
* W. B. TURPIN — Asst Chief — Rm 230 Ext 220 — SACVG-A

DESIGN BRANCH
* W. B. TURPIN — Chief — Rm 237 Ext 300 — SACGB

FOUNDATIONS & MTRLS. BRANCH
VACANT — Chief — Rm 138 Ext 363 — SACGF

PLANNING & REPORTS BRANCH
F. A. GRASIER — Chief — Rm 235 Ext 218 — SACGP

PAGES 6 & 7

CONSTRUCTION DIVISION
D. E. EPPERT — Chief — Rm 204 Ext 317 — SACVK
• C. S. MOORE — Asst Chief — Rm 202 Ext 317 — SACVK-A

ENGRG. CONT. BR.
• C. S. MOORE — Chief — Rm 211 Ext 320 — SACKC

OFFICE ENGRG. BR.
H. L. ALLEN — Chief — Rm 205 Ext 315 — SACKE

CONT. ADMIN. BR.
P. G. HORD — Chief — Rm 212 Ext 334 — SACKA

DIST. LAB.
J. A. WOODRUFF — Chief — Rm 215 Ext 326 — SACKL

PAGE 8

SUPPLY DIVISION
• D. H. McDONALD — Chief — Rm 110 Ext 216 — SACVN

CONTRACT BRANCH
(b•) F. MOREHOUSE — Chief — Rm 108 Ext 258 — SACNA

PROCUREMENT BRANCH
* D. H. McDONALD — Chief — Rm 110 Ext 216 — SACNC

PAGE 9

• Dual Assignment

(b•) Small Business & Labor Surplus Advisor

GRAND TOTAL

10 Military

565 Graded
25 Ungraded
590 Civilian

FIELD OFFICES

VAB RESIDENT OFFICE
LT. COL. J. A. BACCI — Res. Engr. — Tele 853-8202 — SAC-VRO

PAGE 10

SOUTH RESIDENT OFFICE
H. L. FREEMAN — Res. Engr. — Tele 853-2322 — SAC-SPO

PAGE 10

WEST RESIDENT OFFICE
R. I. HORNE — Res. Engr. — Tele 853-8610 — SAC-WRO

PAGE 10

COMM & ELCT PROJ OFFICE OPERATIONAL SYSTEMS
F. FALDUTO — Proj. Engr. — Tele 867-2398 — SACKS-C

PAGE 8

COMM & ELCT PROJ OFFICE CABLE
E. L. WOODELL — Proj. Engr. — Tele 867-4313 — SACKS-C

PAGE 8

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U. S. ARMY ENGINEER DISTRICT, CANAVERAL

EXECUTIVE OFFICE

LTC V.D. STIPO, CE — District Engineer
Loc 1 867-2003 — SACVE

1 Secretary (Stenography) — SACVE
Loc 1 867-2003

1 Auto. Equip. Insp. — SACOM
Loc 1 867-8382

MAIL ADDRESS:
P.O. Box 21065, Kennedy Space Center,
Florida 32815
TELEPHONE: AREA CODE 305
AUTOVON: 485 & Last Four Digits
FTS : 867 Numbers Only

SPECIAL ASSISTANTS

LTC W.S. O'SULLIVAN SACEO
Special Ass't to Dist Engineer
Loc 1 867-8384

ADMINISTRATIVE SUPPORT

AFRCE
NASA
NAVY

ADVISORY AND ADMINISTRATIVE STAFF

ADMINISTRATIVE OFFICE

Support Services rendered by the Mobile District.

- AUDIT BRANCH
- BUDGET BRANCH
- FIN & ACCTG BRANCH
- MANAGEMENT ANALYSIS BR
- SUPPLY BRANCH
- ADMIN SVCS BR
- REPRODUCTION BRANCH
- MOTOR POOL

OFFICE OF COUNSEL

Services rendered by the Mobile District.

PUBLIC AFFAIRS OFFICE

LTC V. D. STIPO — Chief
Loc 1 867-2003 — SACVT

SAFETY OFFICE

Services rendered by the Mobile District.

PERSONNEL OFFICE

Services rendered by the Mobile District.

AEROSPACE FACILITIES DIVISION

J. L. GARLAND	CHIEF
Supv. Civil Engr.	GS-14
1 Supv. Architect	GS-13
1 Supv. Structural Engr.	GS-13
1 Supv. Mechanical Engr.	GS-13
1 Supv. Electrical Engr.	GS-13
1 Structural Engr.	GS-13
1 Mechanical Engr.	GS-13
1 Mechanical Engr.	GS-12
2 Electrical Engr.	GS-12
1 Civil Engr.	GS-12
1 Civil Engr. (Estimator)	GS-12
1 Civil Engr. Tech.	GS-12
1 Supv. Civil Engr. Tech.	GS-9
1 Arch. Engr. Tech.	GS-9
1 Civil Engr. Tech.	GS-9
1 Draftsman	GS-5
1 Secretary (Stenography)	GS-4
1 Clerk-Typist	GS-4

CONSTRUCTION DIVISION

F. G. HORD	CHIEF
Supv. Civil Engr.	GS-14
1 Supv. Civil Engr.	GS-13
1 Electrical Engr.	GS-13
1 Supv. Civil Engr.	GS-12
1 Mech. Engr. Tech.	GS-12
1 Civil Engr.	GS-12
1 Civil Engr.	GS-11
1 Engr. Tech.	GS-11
1 DMS & Property	GS-9
1 Mod Clerk	GS-6
2 Clerk Steno	GS-5
1 Clerk Typist	GS-4

1. District Office & Construction Division, Complex 39, Kennedy Space Center.
2. Aerospace Facilities Division, Hangar "I" Annex, Cape Kennedy Air Force Station.

#Staffed by Mobile

APPROVED:
V. D. Stipo
V. D. STIPO, LTC, CE
District Engineer

1 November 1970

APPENDIX "C"

ROTATIONAL TRAINING PROGRAM

FOR

ENGINEER OFFICERS

CANAVERAL DISTRICT

1964 - 1968

ROTATIONAL TRAINING PROGRAM

Policies and procedures were established for administering a Rotational Training Program for Engineer Officers below the grade of Lieutenant Colonel assigned to the Canaveral District for initial tours of District duty. A Deputy Director was appointed by the District Engineer with the responsibility for the immediate direction, supervision and rotational assignment of the officers. Upon assignment of an officer to the District, the Deputy Director scheduled the dates for the officer's various assignments for a 24-month period of training.

Each officer received orientation in Personnel matters; fiscal matters; programming and fund control administered by the Engineering Division; safety procedures; labor relation functions; and contract administration functions as administered by the Supply Division, all in the District Office.

In the Resident Offices each officer was assigned initially as an Assistant Project Engineer and later as a Project Engineer for on-the-job training, with emphasis being placed on the supervision and inspection of construction. Also included in the training was the preparation of contractor pay estimates; quantity takeoffs; progress reports and schedules; and preparation of miscellaneous reports and correspondence.

Assignment to Construction Division provided each officer with on-the-job training in the functions of the Construction Division. Initial assignment was in the Coordination Section, Supervision and Inspection Branch where the officer was charged with responsibility for coordination of assigned contracts. He also received training in the Contract Administration Branch on the mechanics of adjudicating claims; processing steps in the modification flow; and construction management through application of CPM.

In the Engineering Division the officer received training as a Project Engineer, coordinating technical requirements and scheduled projects for the Defense Commands and NASA. He also acted as consultant to the Using Agencies, A-E's and District elements on all matters pertaining to the requirements of the projects.

During the period from March 1964 until January 1968 approximately twelve officers with the rank of Captain and Major completed this training program. Also included were two Engineer Officers from the Royal Canadian Engineers.

This program proved to be a valuable training ground for the future District Engineers of the Corps of Engineers.

APPENDIX "D"

PROGRAM DATA

CANAVERAL DISTRICT

1963 - 1971

PROGRAM DATA

FY	WORK PLACEMENT - MILLIONS $ NASA	MILITARY	TOTAL	NUMBER CIVILIAN PERSONNEL STRENGTH	MILLIONS $ CONSTRUCTION VALUE OF WORK DESIGNED NASA	MILITARY	TOTAL
64	81.6	37.8	119.4	540	142.2	10.4	152.6
65	149.2	17.9	167.1	590	72.0	3.5	75.5
66	96.6	9.8	106.4	522	63.5	2.4	65.9
67	55.5	6.3	61.8	387	34.1	9.3	43.4
68	28.2	4.9	33.1	180	14.2	3.7	17.9
69	11.5	5.3	16.8	167	15.1	1.9	17.0
70	7.8	2.0	9.8	104	11.0	1.2	12.2
71	3.2	0.6	3.8	11	--	--	--
TOTALS	433.6	84.6	518.2	Avg. 313/Yr	352.1	32.4	384.5

Peak Contract Month - January 1965 - 68 contracts awarded $245,155,000.00

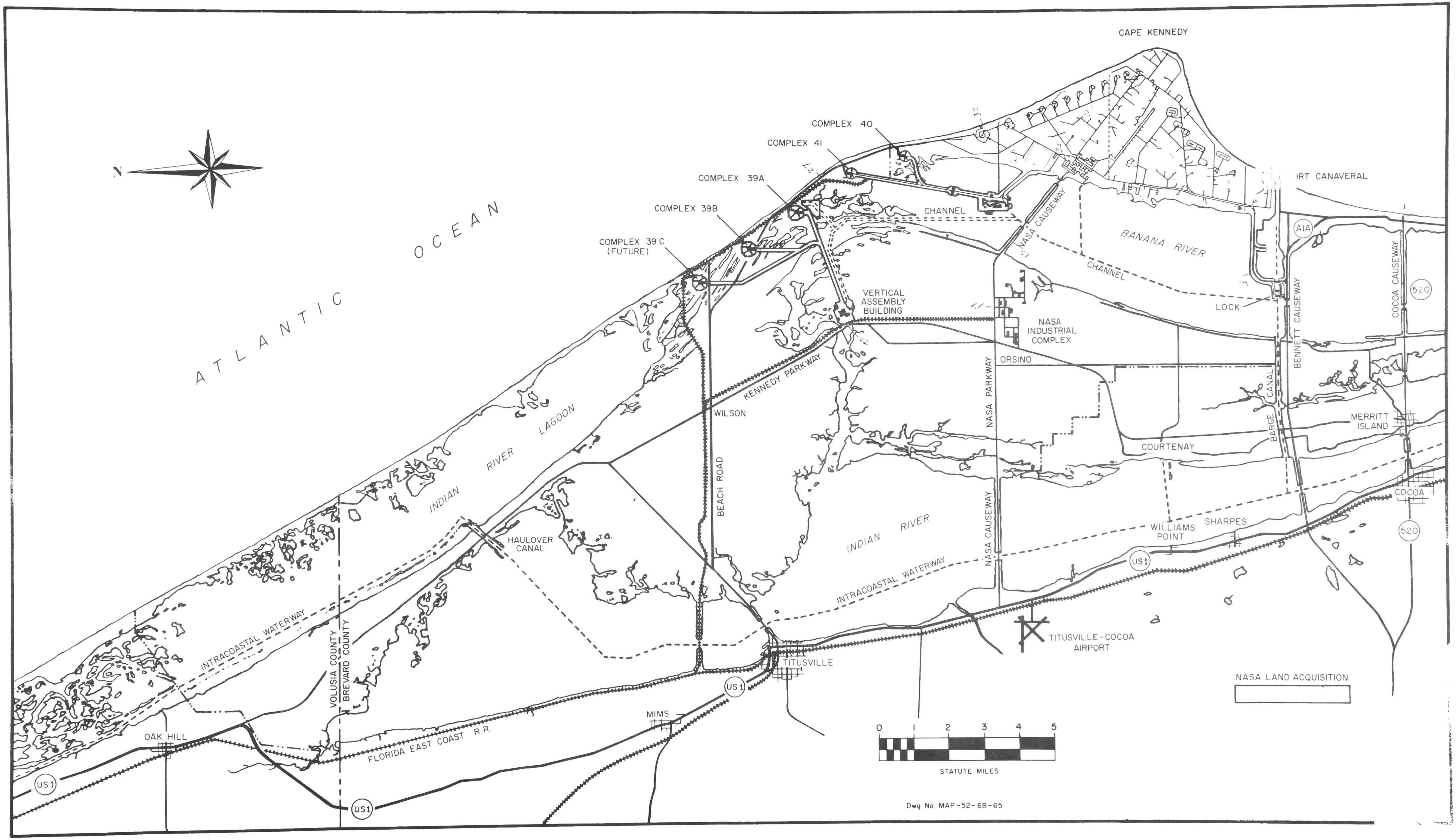
FY	Number of Modifications Processed	Number of Claims Processed
63	148	27
64	1,108	266
65	1,918	203
66	2,515	392
67	2,111	416
68	973	145
69	732	125
70	385	124
71	218	41
TOTALS	10,108	1,739

APPENDIX "E"

MAP OF

CAPE KENNEDY AND

KENNEDY SPACE CENTER



N
CAPE KENNEDY
PORT CANAVERAL
COMPLEX 40
COMPLEX 41
COMPLEX 39A
COMPLEX 39B
COMPLEX 39 C
(FUTURE)
ATLANTIC OCEAN
CHANNEL
BANANA RIVER
CHANNEL
NASA CAUSEWAY
A1A
LOCK
COCOA CAUSEWAY
520
VERTICAL
ASSEMBLY
BUILDING
NASA
INDUSTRIAL
COMPLEX
ORSINO
BENNETT CAUSEWAY
BARGE CANAL
KENNEDY PARKWAY
WILSON
INDIAN RIVER LAGOON
NASA PARKWAY
MERRITT
ISLAND
COURTENAY
COCOA
BEACH ROAD
HAULOVER
CANAL
INDIAN RIVER
NASA CAUSEWAY
WILLIAMS
POINT
SHARPES
US1
INTRACOASTAL WATERWAY
TITUSVILLE-COCOA
AIRPORT
TITUSVILLE
NASA LAND ACQUISITION
VOLUSIA COUNTY
BREVARD COUNTY
MIMS
OAK HILL
FLORIDA EAST COAST R.R.
0 1 2 3 4 5
STATUTE MILES
Dwg No. MAP-52-6B-65